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The effect of wounds upon the rotation of the protoplasm in the internodes of Nitella

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(WITH FOUR TEXT FIGURES)

The cause of traumatic shock has been the subject of many investigations in recent years, especially in the animal kingdom (Cannon **2**, Crile **4**, Mann **14**, Seifriz **17**), although plants have received some attention (Bayliss **1**, Fitting **6**, Lillie **13**). The theories advanced in explanation are somewhat confusing and contradictory.

While studying the process of healing in plant cells, it was observed that the internodal cells of *Nitella* offered an unusual opportunity to study the reactions of streaming protoplasm to wounds. Therefore a series of experiments was carried out in the hope of gaining further evidence as to the traumatic response of active cells and, if possible, the nature of traumatic shock.

That protoplasm will recover from mechanical injury and later show streaming has been demonstrated many times. Hofer (**9**) sectioned *Amoeba* and found that streaming was recovered in the fragments although the nucleus might not be present in the isolated portion. Hertwig (**8**) and Verworn (**18**) sectioned swarmspores and infusoria and found that the ciliated portions regained their movement while non-ciliated sections remained quiet. Hauptfleisch (**12**), Pfeffer (**15**), Gerassimoff (**7**), and Hofmeister (**10**), have obtained similar results in plant cells. By plasmolysis or induction shocks they isolated in the cell non-nucleated portions in which streaming was maintained for several hours.

A portion of the plant two or three internodes long is mounted in a drop of water and under a low power objective punctured,

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free-hand, with a steel needle ground to a very fine point. The effect upon the protoplasm, which I wish to report, is indicated by the change in the rate of movement shown by the particles carried in the streaming protoplasm. The rate is obtained by taking on a stop-watch the time that a grain requires to move five units, equal to 80 microns as measured by the ocular micrometer. The term "normal rate" is used in referring to the average rate at which the protoplasm is moving in the unpunctured cells of the control. The control is a specimen consisting of the same number of internodes, usually three, as nearly as possible of the same age, size and condition as the material under experimentation. Before beginning an experiment a specimen is selected in which the protoplasm is moving at the same rate as that in the cells of the control. The experiment and control material were both handled in the same way and both remained under the same cultural conditions.

As the needle passes through the wall a number of plastids are torn loose, leaving a clear area around the opening. On the withdrawal of the needle from the hole a certain amount of protoplasm with its plastids, starch-grains, and other particles pours out into the surrounding water. The protoplasm is not at once miscible but forms globular masses just outside of the opening. After a minute or two granules begin to accumulate in the opening. This mass seems to harden, forming a plug, and the loss of protoplasm ceases. Gradually a new membrane forms inside of the cell wall separating the plug from the remainder of the protoplasm. The new membrane soon begins to form a new wall and the healing is complete.

By maintaining a clear focus on the point of the needle as it passes through the wall it is possible to observe an immediate retardation or cessation of the streaming movement, which may be general throughout the cell, or be limited to a region near the wound. The effect of the puncture upon the rotation of the protoplasm is influenced by the sharpness of the needle, location of the puncture in the internode, the number of times the internode has been punctured, as well as the size and depth of the wound.

The first puncture of an internodal cell more frequently causes all movement to cease than later punctures made the same day. If the cell is punctured repeatedly for several days,

the first puncture of each day is more apt to cause cessation than later punctures.

The cell wall is very pliable and gives readily before the needle, but if the needle is so sharp that it passes through the wall with very slight bending at the point of contact it forms a puncture that does not cause the movement to cease throughout the cell, but only in a section near the wound. The portion of the protoplasm affected varies according to the character of the wound. When the wound is large (100–200 microns) and followed by a correspondingly large loss of protoplasm, there may be a pronounced retardation throughout the cell, but frequently one end or both will show granules moving at the normal rate. If the puncture is not so large (60–100 microns) movement may be present in the major portion of the cell while the protoplasm is escaping through the partially plugged opening.

When a sharp needle is passed through the wall slowly many of the particles in the field of vision show only a slight, if any, retardation. Just at the time of puncturing some of the granules in the course of the flowing protoplasm both above and below the wound, cease to move, while laterally there are grains that do not show any effect.

A wound of the same size, but made with a quick thrust, always results in a more pronounced reaction as shown by the increased area affected, as well as the longer period required for recovery. That the amount of injury suffered by the protoplasm is dependent on the way the needle is handled has been observed by Chambers (3) and Seifriz (17). Chambers states that "one may puncture a cell with a needle and drag the needle back and forth cutting through the cell, and if the procedure be slow and gradual the tear closes up behind as the needle proceeds and the process may be continued almost 'ad libitum' without producing any ill effect. If, on the other hand, the needle is carried rapidly through the cytoplasm, a few thrusts only are necessary to induce rapid disorganization."

The difficulty of piercing the wall may account for the fact that the most carefully made puncture of a *Nitella* cell is always followed by a definite injury resulting in some retardation for 2–5 minutes at least in the protoplasm passing the wound.

When the needle is slightly dull the wall bends at the point of pressure, and as the needle penetrates, the wall springs back into position, causing a slight jar or vibration to pass through the cell. This action is accompanied by an immediate cessation of movement throughout the cell. Complete cessation of movement throughout was never observed except when it could be accounted for either by the readjustment of the wall or an explosive loss of protoplasm following the puncture. That a jar or any mechanical shock which may start a vibration will cause cessation throughout a streaming cell has been observed and discussed so many times that it does not require further comment at this time (Ewart **5,** Hörmann **11,** Hauptfleisch **12,** Pfeffer **15**).

Movement is not resumed simultaneously throughout the cell, but here and there a granule will be observed to move slowly (20–30 seconds per 80 microns) while the adjacent particles are quiet. The movement spreads rapidly until all the granules are moving except in a region near the wound. Hörmann (**11**) observed that the internodal cell in *Nitella* might show more than one rate of movement under experimental conditions. When he immersed one end of a cell in water and the other in a sugar solution, a decrease in the velocity of movement in the end immersed in the sugar solution was observed. Hörmann thought that this effect was the result of the stimulating action of the sugar solution upon the protoplasm. Ewart (**5**) repeated the experiment and decided that the sugar solution did not act as a stimulus, but through ex-osmosis increased the viscosity of the protoplasm and therefore decreased the velocity of movement.

Recovery in the region near the wound follows the same general course in every case, whether it has been preceded by a general cessation of movement, or only by the formation of a quiet area at the puncture. I will describe one of my experiments in detail in order to outline this process.

An internode 2.5 cm. long and 1.5 mm. wide was mounted and punctured one cm. from the end. The puncture was about midway between the two neutral zones. A quick thrust with a sharp needle formed a puncture 105 microns by 45 microns. The plug formed without excessive loss of protoplasm. At the time of puncturing there was a very slight retardation through-

out the cell and complete cessation of movement in the particles moving toward, and by the wound, for a distance of 160 microns. Some of the particles in the current moving away from the wound ceased to move immediately while others continued to move very slowly (52 seconds per 80 microns). As an immediate result of the wounding in this case, in the region below the puncture and along the lines of flowing protoplasm there were fewer granules visible than in the remainder of the internode. This may be because it is the motion which enables one to see certain of these particles whose optical properties are not very different from those of the mass in which they are imbedded. After one to two minutes there was no visible movement in this area, which could be traced for 1280 microns before it passed out of view around the side of the internode.

The first movement in the quiet area was shown by granules passing the wound laterally. After the first slow movement the rate increased very rapidly until they were moving normally. During the first two or three minutes there was a very slight retardation just as they passed the wound.

After a brief interval (30 seconds) the granules in the line of previous flow and in the direction from which the cytoplasm was coming, were once more carried toward the wound, where their movement was checked. As the granules were checked, some came to rest while others moved laterally and around the wound until they were caught in the adjacent stream of more rapidly moving protoplasm. The movement spread rapidly throughout this region and in a few seconds the whole mass was moving. The rate increased steadily but somewhat more slowly than laterally from the wound, yet in three minutes the whole mass was moving normally.

This checking of the movement in the region of the wound-plug resulted in an accumulation of material just above the wound. This mass soon became so dense that it was impossible to focus on any definite grain to follow its course. Granules were steadily carried out of this mass and borne away in the streaming protoplasm passing the wound laterally. There was the appearance then of two dense masses of moving protoplasm, one extending from each end of the wound.

As the normal rate of streaming was re-established laterally from the wound during the first two seconds, the transition

from the quiet area, down-stream from the wound, to normally flowing cytoplasm was very abrupt. There was a narrow zone about 16 microns wide of slowly moving particles between the two regions. The streaming protoplasm gradually encroached on the quiet area, thus narrowing and shortening the region. This process continued for several minutes. The quiet area was capped and bordered by dense masses of slowly moving protoplasm, while the remainder of the cytoplasm in the internode was moving normally, as shown in FIG. 1.

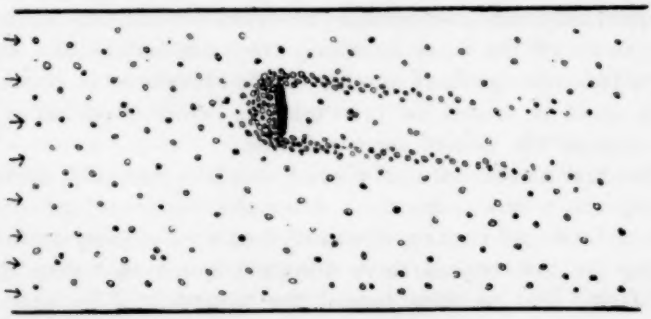

FIG. 1. Diagram illustrating the arrangement of granules at the wound about ten minutes after puncturing.

Finally the mass of material pressing against the wound began to pass under the wound-plug, starting a movement in the quiet area on the other side. The granules were moving slowly as they passed the plug, but did not stop entirely when they came in contact with the quiet protoplasm; instead they were carried laterally until they were caught and carried away in the bordering streams of cytoplasm. This action continued for a minute or two. At this time there is movement between the wound and the quiet area below. Focusing through this area, it was sometimes possible to see particles carried along under it as they were under the wound. After about three minutes the entire region began to show movement slowly (30 seconds per 80 microns). The rate increased very slowly. After four hours there was still a noticeable retardation in this region. This was in marked contrast to the procedure in the other portions of the cell where movement once started, gains its normal rate in a few minutes, as shown in FIGS 2 and 3.

The next morning the entire protoplasm of the cell was rotating normally at 1.5 seconds per 80 microns.

Sometimes in puncturing, the number of plastids loosened from the wall was very large, leaving a correspondingly large clear area around the puncture. When this happened it was easier to follow the movement near the wound. In one such instance, when experimenting on an internode containing only

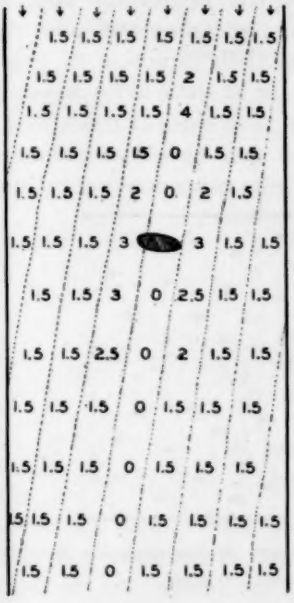

FIG. 2.

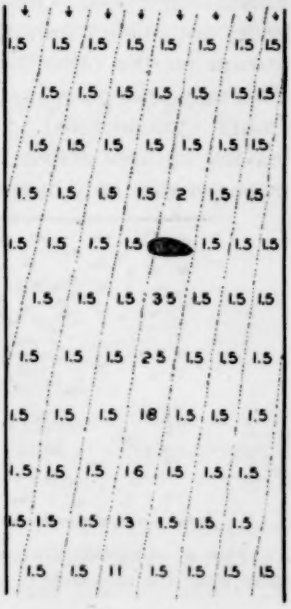

FIG. 3.

FIG. 2. Diagram illustrating the rate at which the granules are carried 30 minutes after puncturing.

FIG. 3. Diagram illustrating the rate at which the granules are carried one hour after puncturing.

The rates shown in the diagrams were obtained by averaging twenty-five experiments. Each numeral indicates the number of seconds taken by a particle in moving 80 microns when in that position in relation to the wound. The granules were timed every alternate 80 microns as long as they were in view.

a few floating particles, it was observed that a mass of dense protoplasm with two or three granules embedded in it was loosened from the wall and carried away in the stream. Apparently this mass formed a portion of the quiet area.

If the puncture is made in the neutral zone the disturbance to the rotation may be very slight. On each side of the zone there is a current toward the wound and the additional quiet

area is correspondingly reduced, facilitating rapid recovery. The final effect is that of a slightly distended neutral zone at this point. Occasionally a very pronounced reaction follows the puncture. As the granules are checked at the wound, some are carried slowly around the wound area, and pass on in their normal direction. Other particles, slightly nearer the neutral zone, are carried toward it, slowly cross the zone and join the stream on the other side, and reverse their direction of flow. This may take place just at the wound, or at some little distance from it (320 microns). It may occur on both sides of the wound, leaving an area across the cell without any visible movement, or one stream only may cross the zone, the other moving by the

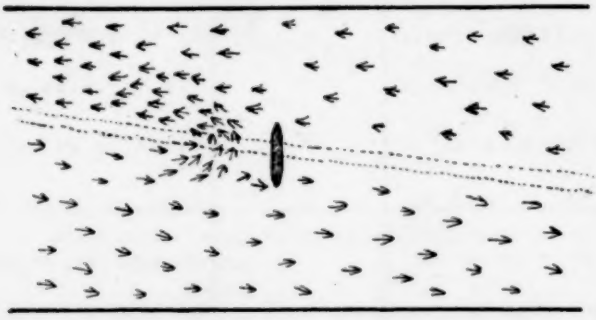

FIG. 4. Diagram illustrating the movement of the granules in some cases when the internode is punctured in the neutral zone.

wound in the normal manner. When this last condition results, the number of granules in one end of the cell increases steadily, while the number in the other decreases, resulting in a very uneven distribution of the material. Slowly the number crossing the neutral zone decreases, while more and more pass around and under the wound until the normal rotation is reestablished (FIG. 4).

Repeated puncturing of the cell, without waiting for the resumption of movement in the protoplasm passing under the wound, results in a more pronounced reaction by the protoplasm. After the third or fourth puncture, recovery is noticeably slower although the general course is the same as after the first puncture. The following table is made from a series of experiments in which the cell was punctured as soon as there was any visible movement, the puncture being made in the section

of the cell where the movement occurred. Each experiment was considered closed when no further movement was observed on the day of the experiment. In every case the normal rate (2 seconds per 80 microns) was present in the cell when examined the next morning.

TABLE SHOWING THE TIME BETWEEN PUNCTURING AND THE FIRST VISIBLE MOVEMENT IN ANY PART OF THE CELL.

No. of the puncture	Exper. 1	Exper. 2	Exper. 3
1	0	30 sec.	0
2	0	0	0
3	1 min.	2 min.	30 sec.
4	2 "	6 "	1 min.
5	4 "	10 "	7 "
6	4 "	11 "	9 "
7	10 "	15 "	10 "
8	12 "	16 "	14 "
9	20 "	18 "	16 "
10	18 "	25 "	21 "
11	27 "	45 "	30 "
12	42 "	1 hr. 12 min.	50 "
13	1 hr. 27 min.	————	1 hr. 40 min.
14	3 hrs.	————	————

If the second puncture is not made until after the movement has been resumed throughout the cell, although there is retardation of the movement in the protoplasm passing under the wound, the reaction may be less pronounced. The time between the puncture and the resumption of movement is shorter, especially in the cytoplasm moving toward the wound. Each successive puncture is followed by a more rapid resumption of movement. After several punctures (five to eight) the protoplasm does not entirely cease to move toward the puncture although it may be retarded as it approaches the wound. Movement from the wound ceases but is resumed after a short pause (two to four minutes). The tenth or thirteenth puncture may be followed by a pause at the wound while the plug is being formed, movement being resumed as soon as the escape of protoplasm ceases. The granules begin to pass the wound immediately, but after passing their rate may be retarded (5–15 seconds per 80 microns). One cell that was punctured seventeen times the same day showed a very prompt return to the normal rate following the last three punctures.

If the change of rate in the streaming protoplasm is a reaction to the wound stimulus it is obvious that this stimulus is not transferred directly any great distance. A wound with a sharp needle, even when very large (200 microns), has never been observed to cause any change of rate in an adjacent node, internode, or leaf cell. If the stimulus is the direct effect of the wound, rather than of the resulting accessory disturbance, such as the loss of protoplasm, the readjustment of the wall, etc., the effect should be manifest before the withdrawal of the needle from the puncture. This is actually the case, since there is a region around the puncture in which all movement ceases momentarily at the time of the puncture and movement may be resumed in portions of this region while the needle is still in the hole formed. With the removal of the needle, and the accompanying outflow of protoplasm, the effect may become general or remain local, as already described. That the disturbance of the protoplasm remote from the wound is due to another factor than the wound stimulus, is indicated by the fact that the non-streaming area does not form immediately, but in the next two or three minutes after the puncture has been made, and its outline is influenced by the direction in which the protoplasm is streaming.

Cannon (**2**) in the discussion of his experiments on traumatic shock, distinguishes primary shock, which he thinks is probably due to some nervous disturbance, and secondary shock, which he ascribes to some toxic element. This toxic substance, possibly a proteid cleavage product, enters the circulation and causes disturbances in the system that are manifest sometime after the wound has been received. The time between the injury and the development of the secondary shock may be hours, or it may be weeks.

The phenomena in the *Nitella* cell suggest perhaps a similar situation. The cessation or retardation of movement which may immediately result from the puncture may be a matter of direct stimulation. Lillie (**13**) believes that any local stimulus alters the plasma-membrane, and this starts an electric current which is propagated through the cell membrane and thus the transmission of the stimulus is very rapid. This stimulus thus propagated, produces a response throughout the cell, which he compares to the "none or all" response of a muscular fibre.

Bayliss (1) working on *Amoeba* and *Nitella* was able to show that a weak electric current would change the moving protoplasmic hydro-sol to a non-motile gel. This gel reverts to the sol and movement re-commences as soon as the current is removed.

A primary effect of this sort may or may not be evident in *Nitella*, but what apparently corresponds to the secondary effect always follows the puncturing of a *Nitella* cell. When the needle enters the cell more or less protoplasm is injured. Toxic substances liberated by this injured protoplasm may be responsible for the subsequent changes in the streaming. Retardation or cessation of streaming may be due to the fact that the protoplasm becomes more viscous or passes into a gel. As would be expected, this region is not well developed on the side where the cytoplasm is moving toward the wound and the toxic substance has to diffuse against the stream, or is limited to the area through which it can diffuse during the time of rest. On the other side of the wound the toxic substance may be carried by the current present, which explains the gradual development of the reaction in this region as well as its more permanent character.

A toxic substance, formed by the injured protoplasm and present in the region washed by the cytoplasm passing the wound, might account for the effect on the plastids in this section. If the protoplasm in this region remains quiet for any length of time the plastids die, lose their color, and finally disintegrate. Plastids that are much nearer the wound, but are not in contact with this protoplasm, remain normal.

Such a substance must be assumed to be given off by the wound for some time, two or four hours, since the moving protoplasm is retarded for this length of time, as it passes the wound. This retardation is not the result of a purely mechanical obstruction by the internal plug, for the amount of retardation gradually lessens until it disappears, while the internal plug remains for days.

Fitting (6) found that an extract of filter paper contained a substance which would start active rotation in the quiet protoplasm in the cells of *Vallisneria* and *Elodea*. He obtained more pronounced results when he used an extract made from the leaves of *Vallisneria* or *Elodea*. A leaf of *Vallisneria* mounted

in water, and then cut, lost sufficient juice into the water to stimulate movement in the uninjured cells of the leaf. He believed the movement was caused by some substance from the cells, since the protoplasm failed to show any movement if the leaf was washed with fresh water as soon as the cut was made.

These experiments seem to contradict the results obtained with *Nitella*, in which wound substance, as I have interpreted my experiments, seems to check streaming. The contradiction may however be only apparent. It is not impossible that *Nitella* cells also may liberate a similar substance to that which Fitting postulates, which aids in the recovery of motion in the quiet area.

The increased immunity to the toxic substance manifested after several punctures suggests the possibility that an antitoxin or an anti-body of some character may have developed in the protoplasm. The gradual recovery of the injured area as it is washed by the normal protoplasm also suggests such a possibility.

Hörmann (11) Ewart (5) and later investigators, Bayliss (1), Pfeffer (15) state that any decrease in the viscosity of the cytoplasm results in an increased velocity of movement. Repeated puncturing with its accompanying loss of protoplasm may cause a large absorption of water and a decrease of viscosity. That a very large amount of water can be introduced into the protoplasm without serious injury has been shown by the experiments of Chambers (3). A lower viscosity of the protoplasm may be a factor influencing the time necessary for the streaming to regain its normal rate.

I wish to thank Professor R. A. Harper for his interest and assistance in this investigation, which was carried on at Columbia University, while on leave from Oberlin College.

Literature Cited

1. **Bayliss, W. M.** The properties of colloidal systems. IV. Reversible gelation in living protoplasm. Proc. Roy. Soc. London B. **91**: 196–201. 1920.
2. **Cannon, W. B.** Studies in experimental traumatic shock. IV. Evidence of a toxic factor in wound shock. Archives of Sur. **4**: 1–22. *f. 1–6.* 1922.
3. **Chambers, R.** Microdissection studies. I. The visible structure of cell protoplasm and death changes. Am. Jour. Physiol. **43**: 1–12. *f. 1, 2.* 1917.

4. **Crile, G. W.** An experimental research into surgical shock. Philadelphia, 1899.
5. **Ewart, A. J.** On the physics and physiology of protoplasmic streaming in plants. Oxford, 1903.
6. **Fitting, H.** Untersuchungen über die Auslösung von Protoplasmaströmung. Jahrb. Wiss. Bot. **64**: 281–388. *f. 1–3.* 1925.
7. **Gerassimoff, J.** Ueber die kernlosen Zellen bei einigen Conjugaten. Bull. Soc. Imp. Nat. Moscou II. **6**: 109–131. *f. 1–4* + *pl. 1–5.* 1892. (Review: Bot. Centr. **52**: 221–223. 1892.)
8. **Hertwig, O.** Die Zelle und die Gewebe. Jena, 1893.
9. **Hofer, B.** Experimentelle Untersuchungen über den Einfluss des Kernes auf das Protoplasma. Jenaische Zeitsch. Naturw. **24**: 105–176. *pl. 4, 5.* 1889.
10. **Hofmeister, W.** Die Lehre von der Pflanzenzelle. (Handbuch Phys. Bot. Vol. I) Leipzig, 1867.
11. **Hörmann, G.** Studien über die Protoplasmaströmung bei den Characeen. Jena, 1898.
12. **Hauptfleisch, P.** Untersuchungen über die Strömung des Protoplasmas in behäuteten Zellen. Jahrb. Wiss. Bot. **24**: 173–234. 1892.
13. **Lillie, R. S.** The nature of protoplasmic and nervous tranmission. Jour. Physical Chem. **24**: 165–191. 1920.
14. **Mann, F. C.** The peripheral origin of surgical shock. Johns Hopkins Hosp. Bull. **25**: 205–212. 1914.
15. **Pfeffer, W.** The physiology of plants. (Tr. from 2d rev. German ed. by A. J. Ewart.) vol. 3. Oxford, 1906.
16. **Seelig, M. G. & Lyon, E. P.** The condition of the peripheral blood vessels in shock. Jour. Am. Med. Assoc. **52**: 45–48. *f. 1, 2.* 1909.
17. **Seifriz, W.** Observations on the structure of protoplasm by aid of microdissection. Biol. Bull. **34**: 307–324. *f. 1–3.* 1918.
18. **Verworn, M.** General physiology. (Tr. from 2d German ed. by F. S. Lee.) London, 1899.

Notes on Fabaceae—VI

PER AXEL RYDBERG

XYLOPHACOS: VI. GLAREOSI

This group is characterized by the densely woolly, short, more or less incurved fruit, and the loosely villous pubescence of the leaves. The corolla is purple, or ochroleucous with a purple-tipped keel.

Corolla 2–3 cm. long.
- Calyx-teeth nearly half as long as the tube; bracts subulate; pod strongly incurved.
  - Stems usually 1–3 dm. high; pod 2–2.5 cm. long, bent at the middle; corolla purplish..... 32. *X. inflexus*
  - Stem less than 1 dm. long; pod about 2 cm. long, abruptly bent above the middle; corolla ochroleucous, the keel tipped with purple..... 33. *X. incurvus*
- Calyx-teeth less than one-third as long as the tube; stems usually less than 1 dm. long.
  - Leaflets obovate, mostly rounded to retuse at the apex.
    - Calyx black-hairy; corolla bluish, 2.5–3 cm. long. 34. *X. funereus*
    - Calyx white-hairy; corolla rose-purple, white or ochroleucous.
      - Pod comparatively sparingly hairy; bracts subulate, slightly longer than the pedicels; corolla 2 cm. long, ochroleucous or white..... 36. *X. nudisiliquus*
      - Pod very densely villous; bracts lanceolate, more than twice as long as the pedicels.
        - Leaves densely white-floccose; corolla about 2.5 cm. long, rose-purple..... 35. *X. utahensis*
        - Leaves sparingly white-villous; corolla about 2 cm. long, ochroleucous..... 37. *X. subvillosus*
  - Leaflets elliptic or lanceolate, acute or obtuse.
    - Corolla ochroleucous or white, the keel only tipped with purple..... 38. *X. Purshii*
    - Corolla purple or purple-tinged.
      - Peduncles usually not exceeding the leaves.
        - Leaflets oblanceolate, acute; pod rather long-acuminate..... 39. *X. glareosus*
        - Leaflets elliptic, obtuse; pod short-acuminate.
          - Calyx white-hairy..... 40. *X. candelarius*
          - Calyx black-hairy..... 41. *X. ventosus*
      - Peduncles in flower usually exceeding the leaves; pod short-acuminate..... 42. *X. leucolobus*

Corolla 15 mm. long or less.
Corolla ochroleucous; leaflets broadly obovate..... 43. *X. argentinus*
Corolla purplish; leaflets narrowly obovate or oblanceolate.
Racemes usually more than 6-flowered, on very short peduncles; bracts lanceolate, scarcely exceeding the pedicels..... 44. *X. lectulus*
Racemes 2–6-flowered, shorter than the peduncles; bracts subulate, almost half as long as the calyx. 45. *X. lagopinus*

32. XYLOPHACOS INFLEXUS (Dougl.) Rydberg. This species has been confounded with *X. Purshii* on one hand and *X. utahensis* on the other, especially when found in undeveloped specimens. Well developed ones have stems 2–3 dm. long, while in the other two species the stems are always very short. In *X. inflexus*, however, the calyx-lobes are much longer, nearly half as long as the calyx-tube. The bracts and pods are longer, and the latter more curved at the middle.

WASHINGTON: *Vasey;* Alamota, *Piper 1492, 2938*, in 1896, 1899 and 1901; *Elmer 283;* Wawawai, *Piper*, in 1901; *Elmer 112; Hull;* Spokane County, *Sandberg & Leiberg 18;* Walla Walla, *Wilkes Expedition 529;* opposite Alkali, *Howell*, in 1882; Illia, *Piper 665;* Spokane, *Piper 2288;* without locality, *Brandegee 722;* Whitman Co., *Elmer 283; Sheldon 8031;* Spokane, *Piper 2288;* Klickitat Co., *Suksdorf 35*, 1881 (determined as *A. Purshii longilobus* Jones).—OREGON: Independence, *Cusick 1366;* Wallowa County, *Sheldon 8031; 8276*; Snake River, *Cusick 2522.*—IDAHO: Clear Water, *Spalding; Sandberg, MacDougal & Heller 9;* Lewiston, *Heller 3010; Henderson,* Curlew Gulch, *Mulford.*—MONTANA: Helena, *F. W. Anderson, Kelsey;* Lo Lo, *Elrod 114;* St. Ignatius, *MacDougal 285;* Missoula, *MacDougal 126, 236;* Sand Coulee, *Williams 746;* Madison, *Scribner 27d;* Hamilton, *Blankinship 671;* Missoula, *Paulson 58.*

33. **Xylophacos incurvus** Rydberg, sp. nov. Subacaulescent perennial, with a cespitose caudex; stems 1–5 cm. long, densely leafy; leaves 5–9 cm. long; stipules lanceolate, 4–5 mm. long, villous-canescent; leaflets 11–17, oblanceolate or elliptic, acute at each end, 10–15 mm. long, 2–4 mm. wide, villous-canescent; peduncles 3–5 cm. long; racemes 3–7-flowered, dense; bracts subulate, 5–10 mm. long, attenuate; calyx white-villous, the tube about 1 cm. long, 3.5 mm. broad, the teeth subulate, 5–7 mm. long; corolla nearly 2 cm. long, white or tinged with rose-purple, the keel purple-tipped; banner obovate, retuse; wings

about 2 mm. shorter, the blade oblong, acutish, shorter than the claw; keel-petals still shorter and broader, the blade strongly arcuate and rounded at the apex; pod densely white-villous, 2 cm. long, 1 cm. broad and 7 mm. deep, usually sulcate on both sutures except at the apex, strongly incurved almost to a half circle; seeds obliquely reniform, brown, 2.5 mm. long, 2 mm. broad.

Type collected in California, in 1875, *Lemmon 76* (herb. Columbia University).

This might have been included in *A. Purshii longilobus* M. E. Jones, (Zoe **4**: 269. 1893), but the type of the latter was from Tehachapi, Southern California. In his Revision of Astragalus, Jones modifies his description and evidently includes several diverse forms.

CALIFORNIA: *Lemmon 75;* Modoc County, *M. S. Baker*, in 1893; Plumas County, *Heller & Kennedy 8727;* Sierra County, *Lemmon 51;* Upper Sacramento, *Parkinson.*—NEVADA: Carson City, *C. L. Anderson*, in 1864.

34. **Xylophacos funereus** (Jones) Rydberg. (*Astragalus funereus* M. E. Jones, Contr. W. Bot. **12**: 11. 1908). Jones compares this species with *X. coccineus*. To me it seems more related to *X. utahensis*, differing in the larger flowers and fruit and in the black-hairy calyx. It does not have the narrow and almost straight petals of *X. coccineus* and the pod is more curved as in *X. utahensis*. I have seen specimens only from the type locality, Rhyolite, Nevada, but Jones gives also the Charleston Mountains and at Tonopah, Nevada, and Darwin, California.

35. XYLOPHACOS UTAHENSIS (Torr.) Rydberg. This was first described as *Phaca mollissima utahensis* from specimens collected by Stransbury on the northeast shore of Great Salt Lake and on Stansbury Island, though it had been collected before by Fremont in 1845. It is distinguished by the broadly obovate leaflets densely white-villous with matted hairs, the short calyx-teeth and bracts, the peduncles usually exceeding or equaling the leaves, the rose-purple corollas, in drying turning bluish.

UTAH: Numerous collections.—MONTANA: Beaverhead County, *Shear 3350; Payson & Payson 1909; Tweedy 12.*—WYOMING: Uinta County, *A. Nelson 2965.*—IDAHO: Shoup, *Kemp 70;* Challis, *Macbride & Payson 3224; 1764.*—NEVADA: Washoe County, *Kennedy 997; Stretch*, in 1865.

36. **Xylophacos nudisiliquus** (A. Nels.) Rydberg. (*Astragalus nudisiliquus* A. Nels. Bot. Gaz. **54**: 410. 1912.) Nelson described this from fruiting specimens and his description is therefore inadequate. Jones, probably not having seen the type, claimed that it is only an aged form of *A. glareosus*. The habit of the plant, however, is not like that of *X. glareosus* but that of *X. utahensis*. The main difference being in the pod, which in the present species is sparingly hairy and strongly incurved above the middle. There are two specimens from Malheur County, Oregon, which I take to be the same, *Leiberg 2003* in flower and *Leiberg 2243* in late flower and young fruit. Both these are less densely hairy than the type, *Nelson & Macbride 1088*. The fruit of *Leiberg 2243* is similar to that of the type, but younger and hence more thin-walled, the corollas of *No. 2003* are evidently ochroleucous and about 2 cm. long, the calyx white-villous, its tube about 1 cm. long and its teeth subulate and 2–3 mm. long; the bracts are narrower than in *X. utahensis* and much shorter than in *X. inflexus*.

37. **Xylophacos subvillosus** Rydberg, sp. nov. Cespitose perennial with a much branched caudex; stems 5 cm. long or less, leafy; leaves 5–6 cm. long; stipules narrowly lanceolate, 5 mm. long; leaflets 9–15, obovate or oval, 5–12 mm. long, 3–5 mm. wide, rather sparingly white-villous, rounded at the apex; peduncles 2–6 cm. long; racemes 2–6-flowered; bracts linear-attenuate, 4–5 mm. long; calyx loosely villous, the tube 8–9 mm. long, 3 mm. wide, the teeth subulate, 2–3 mm. long; corolla apparently ochroleucous, about 18 mm. long; banner rather broadly obovate, retuse; wings shorter, the blade acutish, oblong; pod densely villous, scarcely 2 mm. long, nearly 1 cm. broad, evenly arcuate throughout.

Type collected in Sierra Valley, California, in 1873; *Lemmon* (herb. N. Y. Bot. Gard.).

The type was labelled by Lemmon *Astragalus eriocarpus* and the duplicate in the Gray herbarium was determined as *A. glareosus*. It has no very close relationship to either, but comes nearest to *A. utahensis* from which it differs in the sparser pubescence and smaller ochroleucous flowers.

CALIFORNIA: Sierra Valley, *Lemmon*, in 1873; without locality, *Kellogg & Hartford 193*.—OREGON: Harney County, *Peck 2797* (This is referred here doubtfully).

38. XYLOPHACOS PURSHII (Dougl.) Rydberg. The plant

was independently described as *Astragalus Purshii* Dougl. from flowering specimens, and *Phaca mollissima* Nutt. from fruiting ones. *A. lanocarpus* Sheld. is nothing but a small-flowered typical *X. Purshii*. Jones, in his Revision, admits 5 varieties of *Astragalus Purshii*. Of these three represent as many good species. The var. *longilobus* I have been unable to place, and var. *interior* is, as far as I know it, of no consequence. It is rather superfluous to cite specimens of this species. Its range extends from British Columbia to Saskatchewan, South Dakota, Nebraska, and Nevada. Specimens cited from California do not belong to it. Specimens in fruit distributed as *A. Booneanus* belong here.

39. XYLOPHACOS GLAREOSUS (Dougl.) Rydberg. This species has been much misunderstood and confused with both *X. Purshii* and *X. inflexus*. Jones for a long time applied the name *A. glareosus* to *X. argophyllus*, and Sheldon redescribed it as *A. allanaris*, perhaps led astray by Jones' application of the name. A. Nelson again redescribed it as *A. Booneanus*, though some of the fruiting specimens referred to the latter belong to *X. Purshii*. *X. glareosus* much resembles in habit *X. argophyllus* and the most important difference is in the fruit. Jones in his Revision made it a variety of *Astragalus inflexus*, but it would have been more proper to make it a variety of *X. Purshii*, and it is more closely related to that species than are *X. leucolobus* and *X. lectulus* which Jones regards as varieties of *A. Purshii*.

The characters separating it from *X. Purshii* are, the purple corolla, the usually longer peduncles and the pod, which is less densely hairy and abruptly incurved above the middle.

BRITISH COLUMBIA: Lake Osoyoos, *Macoun 70443*.—WASHINGTON: Spokane County, *Sandberg & Leiberg 18;* Chelan County, *Griffith & Cotton 168;* Ellensburg, *Piper 2680;* Yakima County, *Cotton 552* in part; *1107; Henderson 2356;* Klickitat County, *Suksdorf 50; Whited 1275* and *18;* Ellensburg, *Whited 273*.—OREGON: Malheur County, *Leiberg 2202, 2158;* Morrow County, *Leiberg 32;* Wasco County, *Lawrence 128, 369;* Baker County, *Peck 10385;* Eastern Oregon, *Cusick 1367, 2522;* Lake Co., *Eggleston 6894, 7023; 6842*.—IDAHO: *Burke;* Elmore County, *Macbride & Payson 2850;* Canyon County, *Macbride 57, 760, 785;* Weiser, *Jones 6228;* also *June Clark 5, 22; Mulford*, in 1892.—UTAH: Cache County, *C. P. Smith 2365*.—WYOMING:

Uintah County, *Merrill & Wilcox 583; A. Nelson 2999, 2990; Parry 79;* Newcastle, *Bates.*—MONTANA: Beaverhead County, *Nelson & Nelson 5416;* Belgrade, *Blankinship 674.*

40. **Xylophacos candelarius** (Sheldon) Rydberg. (*Astragalus candelarius* Sheldon, Minn. Bot. Stud. **1**: 143. 1894.) This is related to *X. Purshii*, differing mostly in the smaller purplish flowers and more densely pubescent and obtuse leaflets. It is evidently the same as *Astragalus Purshii tinctus* M. E. Jones (Zoe **4**: 269. 1893), at least as to the type, though the specimens cited from Ventura and Inyo Counties, California, do not belong to it. It also includes *Astragalus consectus* Sheldon in part. Jones erroneously refers this species to his *Astragalus Newberryi Watsonianus*, i. e. *Xylophacos Watsonianus* (Kuntze) Rydb.

NEVADA: Esmeralda County, *Shockley 33;* Carson City and Virginia City, *Bloomer;* Wasco County, *Sonne 1, 11;* Mt. Gabb, *Purpus 5867;* Pioche, *Minthorn 31* (?)—CALIFORNIA: Nevada County, *Sonne*, in 1887 and 1895; Siskiyou County, *Greene 713; Brown 470; Baker 3557;* Modock County, *Austin & Bruce 2207; G. D. Butler 1283; Manning 715;* Palmetto Range, *Purpus 5879.*—OREGON: Mitchell, Wheeler County, *Peck 10112.*

41. **Xylophacos ventosus** (Suksdorf) Rydberg. (*Astragalus ventosus* Suksdorf Ms.) Perennial, with a tufted cespitose caudex; stems many, less than 5 cm. long, white-villous, densely leafy; leaves spreading, 2–5 cm. long; stipules lanceolate acuminate, 5–6 mm. long. Leaflets elliptic, obtuse, 5–7 mm. long, 2–3 mm. wide, white-villous on both sides, peduncles 1–2 cm. long; racemes 3–6-flowered, sub-capitate; bracts lance-subulate, 5 mm. long; calyx black-villous, often purple-tinged, the tube 10–11 mm. long, 2–3 mm. broad, the teeth subulate, 2 mm. long; corolla purplish, about 2 cm. long; banner obovate; wings slightly shorter, the blades oblong, with a large basal auricle; keel-petals slightly shorter, the blade, strongly lunate, rounded at the apex; pod ovate, lunate, fully 1.6 cm. long, 8 mm. broad and deep, densely woolly.

Type locality; Windy rocky places several kilos east of Bingen, Nov. 10, 1920, *Suksdorf 10662.*

The species is related to *X. candelarius* and *X. glareosus*, but differs from both in the black-hairy calyx, from the former in the somewhat larger pod and from the latter in the broader obtuse leaflets.

WASHINGTON: Klickitat County, *Suksorf 10662, 50,* and *5916;* Rattlesnake Hill, Yakima Co., *Cotton 552.*

42. **Xylophacos leucolobus** (S. Wats.) Rydberg. (*Astragalus leucolobus* S. Wats.; M. E. Jones, Zoe **4**: 270. 1893.) This resembles closely the preceding, but the peduncles usually exceed the leaves, the calyx is often purple-tinged and densely short-villous, its lobes are very short, the pod is more tapering and the wing-petals almost equalling the banner.

CALIFORNIA: San Bernadino County, *Parish 2349, 2998, 4966, 3744, 1813;* Inyo County, *Coville & Funston 543, 783, 496; Elmer 3995; Abrams & MacGregor 236;* Ventura County, *Munz 7014a; Grinnell.*

In specimens from the Tehachapi Mountains of Kern County, the calyx is more long-hairy, its teeth longer, and the bracts subulate attenuate and scarious. *Astragalus consectus* Sheldon was evidently a mixture of three or four species, but the type, not seen by me, apparently belongs to this form.

CALIFORNIA: Kern County, *Abrams & MacGregor 432; Eastwood 3230; Dudley 314; Pringle*, in 1882; *Jones*, in 1897; *Heller 7712.*

43. **Xylophacos argentinus** Rydberg, sp. nov. Subacaulescent cespitose perennial; stems very short and leafy; leaves 4–7 cm. long; stipules lanceolate, 5 mm. long; leaflets 7–13, broadly obovate, about 1 cm. long, rounded or truncate at the apex, silvery-villous; peduncles 3–5 cm. long; bracts lance-subulate, 3–4 mm. long; racemes 2–5-flowered; calyx white-villous, the tube 5–6 mm. long, the teeth subulate, 2–3 mm. long; corolla ochroleucous, 13–14 mm. long; banner obovate; wings slightly shorter, the blades linear, acutish; keel-petals broader, arcuate and rounded at the apex; pod densely white-villous, about 2 cm. long, 8 mm. deep, arcuate above the middle, the sutures slightly sulcate.

Type collected at Lone Pine, California, May 14, 1897, *Jones* (Gray Herbarium).

It resembles *X. utahensis* in leaf-form, pubescence and the fruit, but the corolla is much smaller and ochroleucous.

CALIFORNIA: Inyo County, *Jones* (type); *Heller 8313.*

44. **Xylophacos lectulus** (S. Wats.) Rydberg. (*Astragalus lectulus* S. Wats. Proc. Am. Acad. **22**: 471. 1887.) This resembles *X. candelarius* a good deal, but is smaller, more tufted, with very short peduncles, smaller pod and much smaller flowers, less than 15 mm. long. The pubescence is more like that of *X. utahensis* but the leaflets are narrower. Jones regards it as a variety of *A. Purshii.*

CALIFORNIA: San Bernadino Mountains, *Parish 1812, 2348, 2997; Parry & Lemmon 95;* Sonora Pass, *Brewer 1908, 1882.*

45. **Xylophacos lagopinus** Rydberg, sp. nov. Cespitose perennial with a branched caudex; stems 2–10 cm. long, canescent; leaves ascending, 3–5 cm. long; stipules lanceolate, about 5 mm. long; leaflets 5–9, mostly 7, obovate, 5–10 mm. long, rounded at the apex, silvery-villous; peduncles 1–4 cm. long; racemes 2–6-flowered; bracts lance-subulate, 3–4 mm. long; calyx villous, the tube 4–5 mm. long, 2–2.5 mm. wide, the teeth 1–1.5 mm. long; corolla purplish, about 12 mm. long; banner obovate; wings shorter, the blades lance-linear, acutish; keel-petals much shorter, strongly arcuate and rounded at the apex; pod densely villous, 1.5 cm. long, 1 cm. deep, slightly inflexed.

Type collected on plains between Preneville and Bear Buttes, Crook County, Oregon June 25, 1894, *Leiberg 326* (herb. N. Y. Bot. Gard.).

Jones (Astragalus 224. 1923), included this in *Astragalus Purshii lectulus*, but it differs in the better developed stems and peduncles, longer bracts, fewer flowers, and fewer leaflets.

OREGON: Crook County, *Leiberg 326; Cusick 1951a, 2824; Whited 3029a; E. Nelson 825;* Wheeler County, *Peck 10112, 9745;* Summer Lake, *Bailey 70;* Pumice Plains, *Leiberg 4297;* Lake Co., *Eggleston 6838, 6877;* Laidlaw, *Whited 51.*

VII. COCCINEI

This group is easily distinguished from the rest of the species by its large crimson flowers fully 3 cm. long. It contains only one species.

46. XYLOPHACOS COCCINEUS (Parry) Heller.

CALIFORNIA: San Diego County, *Orcutt; Spencer 235; Mearns 3026; Brandegee*, in 1891; *Eggleston 19818;* Inyo County, *Heller 8190; Austin; Matthews; Coville & Funston 491;* San Bernadino County, *Parish 1280;* Darwin, *Jones*, in 1897; San Jacinto, *Leiberg 3176.*

Studies on the flora of northern South America—VII*

H. A. Gleason

New or noteworthy species of Melastomataceae—II

Saccolena n. gen.

Flowers 5-merous; calyx 10-winged, turbinate, elongated in fruit; petals yellow, obovate; stamens dimorphic; filaments flattened; anthers oblong, opening by a terminal pore, the connective prolonged at base above the insertion of the filament, the conspicuous posterior appendage subulate in the short stamens, ovoid and saccate in the long stamens; ovary superior, 3-winged, turbinate, broadly truncate at the apex.

Cogniaux, in his monograph of the Melastomataceae, recognized seven genera in the tribe Bertolonieae, distinguished fundamentally by the location of the staminal appendage. In the four essentially Andean genera *Diplarpea*, *Monolena*, *Diolena*, and *Triolena*, the appendage is anterior, while in the three Brazilian or Amazonian genera *Bertolonia*, *Macrocentrum*, and *Salpinga*, it is either posterior or else virtually none. *Saccolena* closely resembles *Salpinga* in its trumpet-shaped fruiting calyx, and its relationship is further shown after dissection by the posterior appendage. The two genera differ chiefly in the structure of the stamens and the appendage. In *Salpinga* they are isomorphic, with a slender or subulate erect appendage and also with a short basal posterior spur, while in *Saccolena*, they are dimorphic, not only in length, but also in the character of the appendage, while the short basal spur is lacking. The genus is known only by its type species, which is here described.

Saccolena dimorpha n. sp. Stems herbaceous, branching from the base, simple above, 10–20 cm. tall, 4-angled, minutely pulverulent with reddish resinous globules, the internodes about 1 cm. long; petioles very slender, minutely pulverulent, 12–25 mm. long; leaf-blades broadly ovate, dark green, thin and membranous, the principal ones 30–55 mm. long by 20–32 mm. wide, narrowed or barely acuminate to an obtuse tip, sparsely and minutely ciliate-denticulate, broadly rounded below to an inequilateral base, glabrous, 3–5-nerved, the veinlets inconspicuous; racemes axillary, 6–8-flowered, the peduncles strongly wing-

* Contributions from the New York Botanical Garden, No. 276.

angled, 1–2 cm. long, rhachis 10–15 mm. long; pedicels slender, strongly wing-angled, gradually expanded into the obconic, glabrous, 10-winged hypanthium, together 11 mm. long; calyx-limb 0.8 mm. long; sepals somewhat spreading, triangular, 3.8 mm. long, 2.3 mm. wide, sharply acute, glabrous, faintly veined, with a narrow central wing; petals apparently broadly ovate, yellow, at least 11 mm. long, very thin and membranous; filaments thin and transparent, flat, 1-nerved, 0.7 mm. wide, 2.8 mm. or 4.3 mm. long; anthers oblong, truncate, opening by a terminal pore, 1.5 mm. long, 0.7 mm. wide, the connective 0.8 long above the insertion of the filament, appendage of the short stamens geniculate near the base, subulate, 2.7 mm. long by 0.3 mm. in diameter, appendage of the long stamens ovoid, saccate, 2.3 mm. long, 1.1 mm. wide; fruiting calyx and the strongly thickened pedicel 2 cm. long, prominently wing-angled, expanded at the throat. FIG. 1.

Type, *Bro. Ariste-Joseph A 920*, collected at Paime, Dept. Cundinamarca, Colombia, and deposited in the herbarium of the New York Botanical Garden.

Diolena lanceolata n. sp. Stems herbaceous, branched at the base, simple above, 6–10 cm. tall, closely and densely appressed-pilose above, glabrate below, the internodes about 5 mm. long; leaves firm, narrowly oblong-lanceolate, the largest 35 mm. long by 6 mm. wide, long-acuminate to an obtuse apex, flat or somewhat revolute, barely undulate to entire, sparsely and minutely pilose-ciliate, narrowed at the base into a pilose petiole 1–2 mm. long, bluish-green and glabrous above, closely strigose along the basal portion of the midvein, very sparsely pilose on the surface, especially toward the apex, 3-nerved, the obscure veinlets 2–3 mm. apart, ascending; racemes 2-flowered, from the upper axils, the peduncle pilose like the stem, 3–5 mm. long; pedicels pilose, 2 mm. long; flowers 5-merous; hypanthium broadly campanulate, 3 mm. long and wide, densely strigose, terete above, obtusely 3-winged on the basal 2 mm.; calyx-limb membranous, 0.4 mm. wide, the sepals broadly triangular, 0.6 mm. long, 1 mm. wide, barely apiculate, the exterior teeth subulate-conic, glabrous, 0.6–0.7 mm. long, the free portion of the sepal reduced to a mere line across the inner face of the exterior tooth; petals white, ovate-oblong, obtuse, glabrous; anthers broadly oblong with parallel sides, minutely 4-lobed at the apex, barely tapering at the base, the connective barely prolonged basally, terminated posteriorly by 2 minute, ovoid, saccate lobes 0.05 mm. long, anteriorly by 2 erect, filiform, straight or slightly curved appendages somewhat surpassing the anther; filaments flattened; style stout, terete, glabrous, the stigma capitate; capsule obconic, 3 mm. long, 5–6 mm. wide, 3-winged, glabrate at maturity. FIG. 2.

Type, *Killip 11,537*, collected at Santa Rosa, Dept. El Valle, Colombia, alt. 200–300 m., 22 Sept. 1922, and deposited in the herbarium of the New York Botanical Garden. The sheet exhibits several ripe capsules, but only one unopened flower, from which the above description was made. Its petals are 2.5 mm. long, the anther 1 mm., the anterior appendages 1.2 mm., the filament 0.7 mm., the style 2.6 mm. These dimensions may be too small for the mature flower. The leaves of each opposite pair are somewhat unequal, the smaller averaging two-thirds the length of the larger. *Diolena lanceolata* is obviously related to *D. pileoides* Triana and *D. agrimonioides* Triana. Both the latter have a much denser indument; in the former the smaller leaves are greatly reduced in size, and in the latter the leaves are conspicuously dentate.

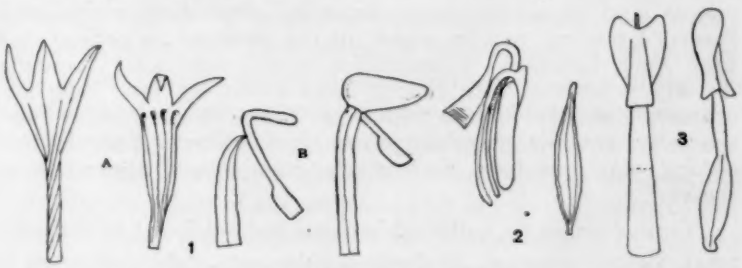

FIG. 1. SACCOLENA DIMORPHA Gleason: A, hypanthium and twisted pedicel × 2, fruiting hypanthium natural size; B, stamens × 10. FIG. 2. DIOLENA LANCEOLATA Gleason, leaf natural size, stamen × 15. FIG. 3. MICONIA KILLIPII Gleason, dorsal and lateral face of stamens × 10.

LEANDRA RUFESCENS (DC.) Cogn. This variable species might easily be divided into several, if attention were paid to characters as minute as those used in various other genera, such as the character, amount, and distribution of pubescence and the details of the venation. Among the recognizable forms, *La Cruz 4480*, from Kaieteur Falls, British Guiana, seems worthy of note. Here the leaves are almost entire, the denticulation being indicated merely by longer cilia at fairly regular intervals. Transverse veinlets between the margin and the outermost vein are absent. Pubescence is completely absent on the upper surface of the leaf, even on the primary veins, at maturity, and rarely extends within the outermost veins even on the young leaves. The calyx is more sparsely hirsute, with less

conspicuous furfuraceous pubescence beneath the hairs, and the ovary is less strongly pubescent at the summit.

Leandra purpurea n. sp. Stem shrubby, 15 dm. high obtusely 4-angled above, later becoming terete, softly hirsute with both glandular and simple spreading hairs 1–1.5 mm. long; petioles stout, channeled above, 2–4 cm. long, hirsute like the stem, but more densely; leaf-blades thin and membranous, ovate-elliptic, sharply and obliquely acuminate, sharply and saliently denticulate (2–5 teeth per cm. of margin, setose, 0.5–1 mm. high) and sparsely ciliate, rounded at the base, upper surface dark green, persistently sparsely pubescent with curved-ascending hairs 0.5 mm. long, densely hirsute on the nerves with erect hairs 1.5–2 mm. long, lower surface paler, softly and thinly pubescent and very sparsely glandular, 5-nerved, the veinlets obscure above, elevated beneath; panicles terminal, 12–15 cm. long, the axes and branches densely hirsute with purple-red simple and glandular hairs, branches divaricate, verticillate; flowers 5-merous, mostly sessile, or the terminal on pedicels 3–8 mm. long, bractless; hypanthium nearly spherical, cinereous, densely pubescent with simple hairs about 0.5 mm. long and sparsely glandular-hirsute with hairs 1 mm. long; berries blue, sparsely villous and glandular, 8 mm. in diameter, spherical; seeds oblong, 0.45 mm. long, with a triangular lateral appendage at the end.

Type, *Gleason 89*, collected in dense upland forest at Tumatumari, British Guiana, 18 June–8 July 1921, and deposited in the herbarium of the New York Botanical Garden. The leaves of each pair are somewhat unequal, the largest one measuring 19 cm. long by 10.5 cm. wide and its opposite 17 cm. by 9 cm. The petiole of the larger leaf is reguarly twice as long as that of the smaller. The pubescence of the stem is brown in color as far as the base of the first panicle-branch, above which it is conspicuously red-purple as far as the hypanthium. The proportion of glandular hairs increases steadily to the apex of the inflorescence. *L. purpurea* is obviously related to numbers 189–193 of Cogniaux's monograph and shows various points of resemblance to *L. verticillata* (L. C. Rich.) Cogn., *L. inaequalifolia* (Schr. & Mart.) Cogn., and *L. polyadena* Ule. It differs from *L. verticillata* in its longer petioles, broader leaves persistently pubescent above, quadrangular branches, and glandular pubescence; from *L. inaequalifolia* in its longer petioles, its erect, purple-red panicle with verticillate branches, and in the greater uniformity in size of the leaves of each pair, and from *L. polyadena*

in its non-glandular, softly pubescent leaves with 5 green nerves, its softer pubescence on the stem, and its shorter sepals.

Among our recent collections of melastomes are three sheets of *Miconia rostrata* (Naud.) Cogn., *Pittier 5886*, *Pittier 10,441* and *E. Pittier 152*, from Venezuela, and two sheets of *Miconia Benthamiana* Triana, *Killip 7791* and *11,454*, from Colombia. Both species have been collected repeatedly in the past, and the present specimens add nothing to our knowledge of their distribution. They have anthers tapering to the apex and octomerous flowers, and were accordingly included by Cogniaux in the section *Octomeris*. But in all superficial characters and habit they suggest at once the genus *Heterotrichum*, and in fact are so closely similar to *H. macrodon*, *H. octonum*, and *H. glandulosum*, even in their more recondite characters, as to raise some doubt as to the validity of generic lines as at present drawn in this region of the family. Throughout the tribe Miconieae the anthers show a considerable degree of uniformity, principally in the absence of the distinctive structural features which are so characteristic of most other tribes, and the genera have been separated largely on the position of the inflorescence, the character of the fruit, and the shape of the petals. In his key to the genera of this tribe, Cogniaux distinguished the two genera only by the nature of the exterior calyx-teeth: "nulli vel inconspicui" in *Miconia*, and "saepius subulati quam interiores majores" in *Heterotrichum*. *Miconia* is also stated to have a 2–5-locular ovary, in contrast to the 6–12-locular ovary of *Heterotrichum*. Our two species actually have 8-locular ovaries, as is beautifully shown on Bentham's plate 34 in the Botany of the Sulphur Expedition for *M. Benthamiana*. The anthers and filaments are essentially the same for *Heterotrichum* and for *Miconia* section *Octomeris*. The only remaining distinction seems to be in the mere length of the external calyx-teeth, a purely quantitative character certainly without generic value. In fact, Naudin combined the two groups in the genus *Octomeris*, a union which seems entirely justifiable and logical, although the differentiation of a special genus for these octomerous plants is hardly necessary. Because of the general similarity in habit and structure to the well-known *Heterotrichum octonum* (Bonpl.) DC., our two species would better be united with it generically, and the following transfers are accordingly proposed.

Heterotrichum rostratum (Naud.) new comb.

Octomeris rostrata Naud. Ann. Sci. Nat. Bot. III. **4**: 53. 1845.
Miconia rostrata Cogn. Monog. Phaner. **7**: 752. 1891.

Heterotrichum polyandrum (Benth.) new comb.

Clidemia polyandra Benth. Bot. Sulph. **95**. *pl. 34*. 1844.
Miconia Benthamiana Triana, Trans. Linn. Soc. **28**: 102. 1871.

The petals are pale purple, 10 mm. long, rather than 4 mm., as stated by Cogniaux (cf. Bentham's plate); the stamens were 40 in each of two flowers examined, and 24 in one flower of *Killip 11,454*. This sheet also has broadly round-ovate leaves almost glabrous above, and shorter, less dense pubescence on the stem.

Amphitoma n. gen.

Flowers 5-merous; hypanthium campanulate; sepals short, the exterior teeth subulate, much exceeding the sepals; petals broadly elliptic, obtuse; stamens 10, all alike; anthers oblong to obovate, 2-celled, introrse, opening by two broad, confluent, terminal pores, the connective prominently thickened below and minutely saccate at the base posteriorly; filaments short, somewhat flattened, the lower portion stout or turgid, the upper slender; ovary mostly inferior, 3-locular, the summit rounded; style straight, terete, subclavate; stigma truncate; fruit baccate, the calyx persistent; seeds smooth, obovoid. Woody plants with strongly flattened, two-edged stems (whence the generic name), opposite leaves with flattened petioles, and terminal, rounded, corymbiform panicles of pedicelled, orange-yellow flowers.

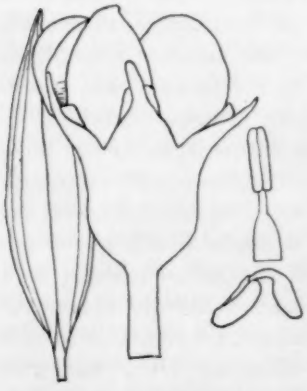

FIG. 4. Flower and stamens × 5, leaf natural size.

Amphitoma flavescens, n. sp. Fruticose; young stems sparsely stellate-puberulent, soon glabrescent, strongly and persistently flattened, sharply 2-winged; leaf-blades thick and firm, oblong-lanceolate, 7–11 cm. long, 12–30 mm. wide, long-acuminate and somewhat falcate, minutely spinulose-denticulate, cuneate at base into a strongly flattened, distally dilated petiole about 1 cm. long, upper surface slightly bullate, minutely punctate, but essentially glabrous, lower surface yellowish green, thinly stellate-tomentulose, especially on the veins, 5-nerved, the outer pair arising from

the intermediate pair about 5 mm. above the base, veinlets 1–1.5 mm. apart, lightly impressed above, prominently elevated and reticulate beneath; panicles terminal, soon appearing lateral by the growth of branches from the uppermost axils, the rhachis and branches flattened below, angulate above, thinly stellate-puberulent, the ultimate branches 3–5 mm. long, jointed at the middle; hypanthium pale brown, 3.5 mm. long and wide, sparsely stellate-puberulent; calyx prolonged 0.7 mm. above the staminal torus; sepals ovate-triangular, 1.3 mm. long, broadly rounded, the free margin scarious; exterior teeth subulate, erect, 2 mm. long, exceeding the sepals by 1 mm.; petals glabrous, 4.5 mm. long, 4 mm. wide, somewhat inrolled; filaments 2 mm. long, glabrous, the lower two-thirds stout, ovoid, 0.8 mm. wide at base, the upper third slender; anthers 1.7 mm. long; ovary glabrous at the summit, radially 10-ribbed; style glabrous, 3–4 mm. long, gradually thickened upwards to 0.6 mm. in diameter; stigma truncate. FIG. 4.

Type, *Killip 11,884*, collected in forest at "La Gallera," Micay Valley, Dept. El Cauca, Colombia, alt. 1800–1900 m., 29, 30 June 1922, and deposited in the herbarium of the New York Botanical Garden. A second sheet, *Killip 7930*, was collected at the same place and altitude 1 July 1922, while the Kew herbarium contains two specimens by Lehmann, numbered *7637* and *8247*. In *Killip 7930*, the panicles are fruiting and considerably enlarged, measuring 10 cm. long from the lowest branch; the leaves are as much as 14 by 3.5 cm., more strongly bullate above, and, as a corollary, more heavily reticulate beneath.

It is a matter for regret that a new genus should be described in the tribe Miconieae, where generic lines are already rather weakly drawn. But I have not been able to assign this remarkable plant to any established genus without a considerable extension of the generic boundary. According to Cogniaux's key, it stands near *Heterotrichum*, agreeing with that particularly in its long exterior calyx-teeth, but having a 3-locular ovary, shorter stamens, and an entirely different habit. Its stamens are distinctly those of a *Miconia*, although they vary in shape even in the same flower, from the oblong ones of *Eumiconia* to the obovate ones of *Cremanium*, but the elongate exterior calyx-teeth are quite unlike *Miconia*.

Miconia polita n. sp. Section Jucunda; fruticose, 2 m. high, strictly glabrous to the inflorescence; stems brown, terete or nearly so, the upper internodes flattened, elongate; petioles

slender, 3–3.5 cm. long; leaf-blades pale green, shining, rigid but thin, lance-elliptic, 22–24 cm. long, 7–8 cm. wide, acuminate to a blunt tip, entire, remotely spinulose-ciliate, narrowed to an acute base, 5-nerved, the veinlets conspicuous, 6–9 mm. apart; peduncle terminal, glabrous, 3 cm. long; panicle pyramidal, 9 cm. long, branches spreading, 2–4 at each node, sparsely glandular-villous, especially at the nodes; pedicels 2–3 mm. long, glandular-villous; flowers 5-merous; hypanthium cylindric, 5 mm. long, 2 mm. wide, obscurely 10-nerved, sparsely glandular-villous with spreading hairs 0.6 mm. long; sepals spreading, triangular-acuminate, 1.3 mm. long, 1.5 mm. wide at the base, acute, sparsely glandular-villous like the hypanthium; petals white, narrowly obovate-oblong, 5 mm. long, 2.3 mm. wide, obtuse, glabrous, membranous, finely nerved; filaments filiform, glabrous, 3 or 5 mm. long; anthers subulate, strongly introrse-arcuate, 3.5 mm. long, opening by an oblique introrse pore, the anther-sacs prolonged 0.2–0.3 mm. and rounded at base; connective not prolonged, unappendaged, glabrous; ovary mostly free, glabrous, 3-locular, the summit broadly rounded and retuse; style straight, declined, 10 mm. long, glabrous; stigma punctiform.

Type, *Gleason 53*, collected in dense upland forest, Tumatumari, British Guiana, 18 June–8 July 1921, and deposited in the herbarium of the New York Botanical Garden. The remarkably shining surface of the leaves is unique in the section. Mr. N. E. Brown has noted on the type sheet "This is identical with an unnamed *Miconia* in the British Museum labelled 'Guiana Belgica, Alex. Anderson.' "

MICONIA GUIANENSIS (Aubl.) Cogn. This is probably the commonest melastomataceous tree in British Guiana. It certainly is the most abundantly represented in herbaria, possibly because of its conspicuous clusters of white-bracted flowers. Our ample series of specimens shows a considerable range of variation, among which three deserve special mention. Here the leaves are distinctly obovate and rounded above to a short cuspidate tip. They are *La Cruz 2373* and *2805*, from the upper Mazaruni River, and *La Cruz 1716*, from the upper Rupununi River.

MICONIA MACROTIS (Griseb.) Cogn. The section *Adenodesma* is characterized by glandular connectives at the base of the anthers. This species, characterized by huge leaves deeply auriculate-cordate at base, is represented in our collections by a recent

specimen from Trinidad, *E. G. Britton 2840*, as well as by older material by Kuntze and Broadway. It should be noted that the glandular nature of the connective is very obscure, and I have not been able to observe it until after boiling and carefully isolating a stamen under a considerable magnification. On such treatment it is also seen that the base of the anther-sacs is considerably prolonged, a character foreign to most Miconias. The anthers are 5–5.5 mm. long, and abruptly narrowed above the middle into a very slender apex. The petals are narrowly obovate and densely stellate-tomentose externally.

The flowers are undoubtedly 6-merous, with a 4-locular ovary, although Cogniaux states that 5-merous flowers characterize the section. Cogniaux, in his monograph, doubtfully refers here also a specimen from Ecuador, collected by Poortmann, which I have not seen, but which may well be the same as *Hitchcock 21,315*. The latter agrees precisely with the Trinidad sheets in foliage and hypanthium, the stem is more closely velutinous, the petals have the same shape, and the anther-sacs are similarly prolonged. But certain differences are as striking as these similarities, and have led me to distinguish it as a variety.

Miconia macrotis canescens n. var. Petals canescent externally with short, straight, simple hairs; anthers 8 mm. long, gradually tapering from base to apex.

Type, *Hitchcock 21,315*, collected between Porto Velo and El Tambo, Prov. Oro, Ecuador, alt. 600–1000 m., 2 Sept. 1923, and deposited in the herbarium of the New York Botanical Garden.

There is not only great habital similarity between *M. macrotis*, of the section *Adenodesma*, and *M. Boisseriana* Cogn., a Cuban species of the section *Tamonea*, but also a strong resemblance in other more recondite points of structure. Both seem to be derivatives of the widely distributed *M. macrophylla* (D. Don) Triana.

Miconia plumosa n. sp. Small tree, 5 m. tall; stems stout, densely hispid-tomentose with recurved-spreading, slightly plumose, brown hairs 3–4 mm. long and straight, more or less reflexed, densely plumose hairs 2 mm. long; petioles hispid like the stem, 5 mm. long; leaves of each pair strongly unequal, the blades thick and firm, obovate-oblong, entire, abruptly narrowed at the apex to a subulate-triangular cusp 1 cm. long, gradually tapering below to a truncate or rounded base 10–15

mm. wide, upper surface dull green and glabrous, lower surface thinly stellate-pubescent and strongly reticulate, 3-pli-nerved, the midvein closely stellate-tomentose for half or more of its length and also sparsely pilose with spreading simple hairs 2–3 mm. long, the lateral veins arising 3–7 cm. above the base, glabrous, the veinlets conspicuous, 5–8 mm. apart; panicle cylindrical, narrow, crowded, 2 dm. long, hispid like the stem, the lateral branches 2–5 mm. long, bearing 2–7 sessile, 5-merous flowers; bractlets linear-subulate, 5–8 mm. long; hypanthium urceolate-campanulate, 5 mm. long, densely stellate-tomentose; sepals broadly triangular, obtuse, 1 mm. long; ovary 3-locular, depressed at the summit; seeds obovoid-prismatic, truncate, 1 mm. long.

Type, *Gleason 901*, collected on dry sandhills, east of Rockstone, British Guiana, 22–30 July 1921, and deposited in the herbarium of the New York Botanical Garden. It is a member of the section *Adenodesma* and related to *M. tomentosa* (L. C. Rich.) D. Don, from which it differs in its strongly hispid stem, its hispid midvein, its rounded leaf-bases, and its more congested panicle. The type specimen bears only the two uppermost leaves, measuring 22 by 9 and 41 by 20 cm.

Miconia imbricata n. sp. Arborescent; branches terete or nearly so, densely and coarsely furfuraceous-tomentose with dark brown hairs; petioles stout, 6–10 mm. long, pubescent like the stem; leaf-blades narrowly oblong-obovate, thick and firm, 5–7 cm. long, 2–3 cm. wide, obtuse or abruptly subacuminate to an obtuse apex, narrowed from above the middle to an obtuse base, minutely spinulose-ciliate, 5-nerved, upper surface dull yellowish-green, glabrous, somewhat rugose, with prominently impressed veins and veinlets, lower surface dull brown, pubescent, especially on the veins, with crooked or crisped, black or brown hairs; panicles terminal, 3–5 cm. long, lax, few-flowered, pubescent like the stem; flowers 5-merous, on pedicels 4–8 mm. long; hypanthium campanulate, 5 mm. long, 4 mm. in diameter at the summit, minutely and scabrously pubescent, with a few long hairs at the top; calyx prolonged 1 mm. beyond the hypanthium, somewhat flaring; sepals round-ovate, 1.9 mm. long, 2.8 mm wide, obtuse, the free margin glabrous, membranous, white, exterior teeth stoutly subulate, erect, sparsely short-hirsute, equaling the sepals; petals white, broadly rotund, 9 mm. wide, 7 mm. long, strongly retuse, glabrous, many-nerved, widely overlapping; anthers (not fully mature) lanceolate, 3.8 mm. long, 1.2 mm. wide at base, tapering to the obtuse apex, the connective slightly thickened on the back toward the base and minutely 2-saccate; filaments about 4 mm.

long, strongly flattened, glabrous; ovary 5-locular, the summit conspicuously truncate-conic, 5-ribbed, glabrous; style 4 mm. long, straight, terete, glabrous; stigma truncate, not expanded, 0.6 mm. in diameter.

Type, *Pennell 10,503*, collected in mossy forest, Cerro Tatama, Dept. Caldas, Colombia, alt. 3200–3400 m., 8–10 Sept. 1922, and deposited in the herbarium of the New York Botanical Garden. It is a member of the section *Octomeris*, related to species 62–65 of Cogniaux's monograph, but differing from them in many features of size, shape, and pubescence.

Miconia rupicola n. sp. Stems shrubby, obscurely 4-angled, minutely and sparsely stellate-furfuraceous above, glabrescent with age, sparsely setose in the axils; petioles slender, 8–18 mm. long, stellate-furfuraceous above, glabrate beneath; leaf-blades firm, obovate-oblong, 8.5–10.5 cm. long, 4–5.5 cm. wide, broadly obtuse or rounded above to a minute, ovate, blunt apex, minutely and remotely denticulate, obtuse at base, glabrous and densely punctate above, thinly furfuraceous beneath, especially on the veins, 5-nerved, the outer pair obscure, veinlets inconspicuous and reticulate; panicle 5 cm. long, lax, few-flowered, stellate-furfuraceous; flowers 8-merous, sessile or on pedicels 1–3 mm. long; bud broadly fusiform, blunt, 8 mm. long, rupturing irregularly below the middle; hypanthium broadly campanulate, minutely stellate; petals 8 mm. long, glabrous externally.

Type, *Killip 11,685*, collected on exposed cliffs, Buenaventura, Dept. El Valle, Colombia, alt. 0–10 m., 5–10 Oct. 1922, and deposited in the herbarium of the New York Botanical Garden. It differs from *M. notabilis* Naud., the only other 8-merous species of the section *Laceraria*, in its furfuraceous pubescence, its broader and blunter leaves, its shorter pedicels, and its glabrous petals.

Miconia Smithii Cogniaux, n. sp. Arborescent, 6–10 m. high; stems obscurely 4-angled and minutely stellate-furfuraceous when young, terete and glabrescent with age; petioles slender, 20–25 mm. long, thinly stellate-pubescent; leaf-blades subcoriaceous, narrowly ovate-oblong, 8–11 cm. long, 3.5–4.5 cm. wide, abruptly short-acuminate to an obtuse apex, entire or obscurely and remotely undulate, rounded at base, shining and glabrous above, or minutely puberulent along the lower portion of the midvein, minutely stellate-pulverulent beneath, 5-nerved; panicle 8–10 cm. long, stellate-pubescent, its branches spreading, simple, spiciform; flowers 5-merous, sessile, approximate above, becoming 3–6 mm. apart; hypanthium broadly campanulate, 2 mm. long, glabrous; sepals subscarious, semi-

circular, 0.5 mm. long, 1 mm. wide, glabrous, minutely erose on the margin; petals broadly ovate, obtuse, 2 mm. long, entire, glabrous; filaments 2.3 mm. long, glabrous, the lower two-thirds flat, 0.5 mm. wide, the upper one-third slender; anthers linear, 1.7 mm. long, glabrous, the connective thickened below and bearing an ascending posterior appendage 0.2 mm. long; ovary rounded at the summit, glabrous; style straight, 3 mm. long, glabrous, gradually thickened upward to a truncate stigma.

Type, *Smith 1846*, collected in open mountain forest, Sierra del Libano, alt. 6000 ft., Santa Marta, Columbia, 27 Feb. 1899, and deposited in the herbarium of the New York Botanical Garden. It is a member of the section *Eumiconia*, subsection *Diplostachyae*, and stands according to the arrangement in Cogniaux's monograph, next to *M. Mendoncaei* Cogn., a Brazilian species with large, thin, sharply acuminate, serrulate, ciliate leaves and furfuraceous calyx.

Miconia panicularis n. sp. Stems woody, prominently flattened and densely brown-velutinous with stellate hairs above, becoming terete and glabrate in age; petioles stout, flattened above, 10–15 mm. long, densely velutinous; leaf-blades dark green, membranous, oblong-obovate, 25 cm. long by 12 cm. wide at maturity, abruptly and sharply acuminate, entire, narrowed from the middle to the acute base, essentially glabrous above, minutely and very sparsely stellate-pulverulent beneath on the surface, more densely so along the veins, 5-nerved, the outer pair less prominent but extending to the apex, veinlets conspicuous, 7–9 mm. apart; panicle broadly pyramidal, 15 cm. long and wide, the rhachis densely stellate-velutinous, the branches thinly so; pedicels 0.5 mm. long, thinly stellate-furfuraceous; flowers 5-merous; hypanthium campanulate-cylindric, 1.6 mm. long, minutely and sparsely stellate, especially at the base; sepals broadly depressed-triangular, 0.6 mm. long, puberulent, membranous and rounded at the apex, the exterior teeth conic, 0.2 mm. long; petals apparently white, narrowly obovate, 2.3 mm. long, 1.1 mm. wide, narrowed to the base, rounded at the apex, glabrous; filaments filiform, glabrous, 2.7 mm. long; anthers linear-oblong, 2.3 mm. long, obtuse at the apex, truncate and minutely bigibbous at base posteriorly, opening by a single terminal pore, the connective not prolonged; summit of ovary hemispheric, glabrous, with 10 rounded ribs; style stout, straight, terete, glabrous, 3.7 mm. long, 0.4 mm. in diameter; stigma truncate, 0.6 mm. in diameter; fruit globose, 3 mm. in diameter, nearly glabrous, the calyx-limb persistent.

Type, *La Cruz 4445*, collected at Kaieteur Falls, Potaro River, British Guiana, 23 Oct.–3 Nov. 1923, and deposited in

the herbarium of the New York Botanical Garden. Other collections are *La Cruz 4434*, from the type locality, *La Cruz 3908* and *3957*, from the Wanama River, and *La Cruz 3737*, from the Waini River, Northwest District, British Guiana. The description of the fruit is taken from the last specimen. The species is a member of the section *Eumiconia*, and related to *M. Beurlingii* Triana, from which it differs in its broader and larger leaves, more abruptly acuminate, and with more prominent tertiary veins, less densely stellate hypanthium, longer sepals, and more densely pubescent inflorescence. One of the specimens was noted by the collector as a tree 20 ft. high.

Miconia caucana n. sp. Stem irregularly flexuous, freely branched, probably scandent, thinly stellate-tomentulose when young, glabrescent with age; petioles slender, 5–10 mm. long, tomentulose like the stem; leaf-blades membranous, oblong-elliptic, varying to oblong-obovate or narrowly ovate, 5–7 cm. long, 18–25 mm. wide, sharply acuminate, entire, acute or cuneate at base, upper surface dark green, sparsely pilose with subappressed straight hairs about 0.6 mm. long, lower surface pale green, stellate-tomentulose on the veins, minutely stellate-pulverulent on the veinlets, 3-nerved; panicles numerous, terminating all the branches, 2–4 cm. long, lax, few-flowered, the rhachis and branches stellate-tomentulose; flowers 5-merous, on pedicels 1–2 mm. long; hypanthium campanulate-cylindric, faintly 10-ribbed, 2.2 mm. long, thinly stellate; sepals triangular, 1 mm. long and wide, sharply acuminate, conspicuously reflexed, minutely pubescent, the exterior teeth conic-subulate, equaling the sepals; petals apparently yellow, oblong-obovate, 3.5 mm. long; anthers linear, 3.2 mm. long, opening by a single terminal pore, the connective dilated at base anteriorly into two ovoid, introrse appendages 0.2 mm. long; filaments filiform, glabrous, 3.3 mm. long; ovary summit hemispheric, glabrous, minutely 10-ribbed; style slender, somewhat declined, 6.3 mm. long, slightly thickened near the apex to the truncate stigma.

Type, *Holton 909*, collected at La Paila, Dept. El Cauca, Colombia, 18 Apr. 1853, and deposited in the herbarium of Columbia University at the New York Botanical Garden. It is a member of the section *Eumiconia*, subsection *Paniculares*, although its foliage resembles that of *M. ambigua* (Bonpl.) DC. and *M. virescens* (Vahl) Triana, of the subsection *Seriatiflorae*. Under the arrangement of Cogniaux's monograph, it may be placed near *M. gracilis* Triana and *M. hyperprasina* Naud.

Miconia pulvinata n. sp. Frutescent, 1.5 m. high; stems obscurely 4-angled, setose at the nodes, otherwise glabrous; leaf-blades deep green, membranous, oblong, 19–25 cm. long, 6.5–9.5 cm. wide, acute or subacuminate, prominently crenate-serrate and ciliate, acute or cuneate at base, glabrous above, sparsely hirtellous beneath, especially on the veins, 5-nerved, the outer pair obscure, the intermediate pair near the margin, the veinlets conspicuous beneath, strongly ascending; petioles stout, 5–7 mm. long, glabrous beneath, densely pilose above; panicle slender, pilose-tomentose at the nodes, the smaller branches more or less pubescent; bracts minute, narrowly triangular, hirtellous; flowers 5-merous, sessile, secund; hypanthium glabrous; calyx truncate, the sepals reduced to minute teeth, persistent on the globose, blue fruit.

Type, *Smith 1841*, collected in the mountain forest at Las Patidas, Santa Marta, Colombia, 25 Jan. 1899, and deposited in the herbarium of the New York Botanical Garden. The character of the inflorescence, the setose nodes, the 5-nerved leaves, and the truncate calyx leave no room for doubt as to its close relationship to *M. racemosa* (Aubl.) DC., which is an Amazonian species extending west into Venezuela. Our species differs conspicuously in its narrower leaves on very short, densely pilose petioles.

Miconia virgulata n. sp. Stems slender, woody, obtusely 4-angled, the upper internodes alternately glabrous and densely tomentose on the four sides, the tomentum deciduous on the lower internodes, which remain distinctly verrucose; petioles slender, 4–7 mm. long, glabrous below, densely pilose-tomentose near the apex, especially on the upper side; leaf-blades firm, narrowly lanceolate, 45–75 mm. long, 7–13 mm. wide, subacuminate, prominently pilose-ciliate, acute at base, dark green above, brownish-green beneath, glabrous on both sides, 3-nerved; panicles 3–4 cm. long, the rhachis pubescent like the stem, the lateral branches short, spreading, nearly glabrous; bractlets minute, ovate, fimbriate-ciliate; flowers sessile, secund, 5-merous; hypanthium campanulate, 2 mm. long, glabrous; sepals minute, broadly rounded, 0.3 mm. long, glabrous; petals oblong-obovate, 1.5 mm. long, truncate, glabrous; anthers thick, oblong, 1.2 mm. long, opening by a single terminal pore, the connective not prolonged at base; filaments slender, 1.4 mm. long.

Type, *Jenman 7441*, collected on the Curiebrong (Kuribrong) River, British Guiana, Oct. 1898, and deposited in the herbarium of the New York Botanical Garden. Although distributed as a Jenman collection, the name of the actual collector is not known.

M. virgulata is another relative of *M. ciliata* and *M. racemosa*, as shown by its secund inflorescence, its nearly truncate calyx, its pubescent petioles, and its strongly ciliate leaves. It is beautifully characterized by the two strips of tomentum on the stem, extending up from the base of each leaf, and is also distinct in general habit, because of its small, narrow leaves and short internodes 5–10 mm. long.

Miconia Killipii n. sp. Low tree, 3.6 m. tall; stems obtusely 4-angled, shallowly 4-sulcate, and thinly furfuraceous-pulverulent above, becoming subterete and glabrate with age, thickened at the nodes; petioles slender above a conic base, 13–17 mm. long, pulverulent like the stem; leaf-blades thin but firm, ovate-oblong, 8–11.5 cm. long, 4–5.5 cm. wide, short-acuminate to a broad, obtuse tip, entire, broadly rounded below to a truncate base, glabrous, 5-pli-nerved, the outer pair obscure, the intermediate pair arising 2–3 mm. from the base; veins lightly impressed above, prominently elevated beneath, veinlets about 6 mm. apart, obscure above, prominulous beneath; panicle 13 cm. long, sparsely branched, widely spreading, furfuraceous-pulverulent like the stem, the rhachis 4-sulcate, the smaller branches nearly or quite terete; bracts none or caducous; pedicels 2–3 mm. long; flowers 5-merous; hypanthium broadly campanulate, 2.5 mm. long, 3.5 mm. wide, thinly pulverulent; sepals thick and heavy, broadly triangular, 0.9 mm. long, nearly 2 mm. wide, obtuse, exterior teeth none; petals pink-blue, short-ovate from a broadly truncate base, 3.3 mm. long, 4 mm. wide, glabrous within, minutely pulverulent without; anthers thick, broadly ovate, 2.4 mm. long, 1.3 mm. wide, rounded at the apex, the anther-sacs 1.7 mm. long, opening by a single minute terminal pore, connective thickened on the back and strongly thickened below the anther-sacs; filaments stout, flattened, 2–2.3 mm. long, 1.2 mm. wide at base, the distal half (and the base of the connective) densely glandular; ovary truncate at the summit; style 4 mm. long, thickened upward from 0.6 mm. in diameter at the base to 1.0 mm. at the summit; stigma peltate, flat, 2.1 mm. in diameter. FIG. 3 (see page 375).

Type, *Killip 11,415*, collected along open trail at La Cumbre, Dept. El Valle, Colombia, alt. 1600–1800 m., 11, 19, Sept. 1922, and deposited in the herbarium of the New York Botanical Garden. The plant is a member of the section *Amblyarrhena*, and of the general affinity of *M. grandiflora* Cogn., *M. majalis* Cogn., and *M. floribunda* (Bonpl.) DC. It differs from these in the size of the flower, the size, shape, and pubescence of the foliage, and above all in its remarkable ovate anthers. I have

not been able to compare it with two other species of the group, *M. macrantha* Triana and *M. lamprarrhena* Triana, neither of which was seen by Cogniaux. Of these, the former is described with much larger flowers, and the latter agrees with our plant in only a single point of description, the puberulent petals.

Miconia scutata n. sp. Stems woody, essentially terete and glabrous below the inflorescence; petioles stout, glabrous, 6–10 mm. long, expanded at base into a spreading, corky or cartilaginous, horseshoe-shaped appendage 1–2 mm. wide; leaf-blades oblong, thick and firm, 15–23 cm. long, 5.5–7 cm. wide, obtuse or subacute at the apex, minutely and remotely denticulate, cuneate to the base, dull green and glabrous above, very minutely and sparsely rufescent-punctate beneath, especially along the veins, 5-nerved, the outer pair obscure and submarginal; panicles widely spreading, freely branched, the rhachis and branches sharply angled, minutely furfuraceous-punctate; pedicels less than 1 mm. long; flowers 5-merous; hypanthium subcylindric, 2.5 mm. long, obscurely punctulate; sepals membranous, oblong-obovate, 0.6–0.8 mm. long, truncate or obtuse, the exterior teeth flat, appressed, triangular, 0.5 mm. long; petals obovate from a narrow base, 2.3 mm. long, broadly rounded at the apex; anthers oblong, blunt, thick, 2.3 mm. long, 0.8 mm. wide, opening by a terminal pore 0.3 mm. wide, slightly attenuate at base, the anther sacs minutely prolonged anteriorly and the connective posteriorly (about 0.1 mm.); filaments slender, slightly flattened, 3.3 mm. long, glabrous, attenuate in the upper third; ovary-summit conic, glabrous, with 10 radial ribs prolonged around the style into erect, linear appendages 0.3–0.4 mm. long; style slender, 6 mm. long, glabrous, minutely thickened upward; stigma capitate, 0.8 mm. in diameter.

Type, *Hitchcock 21,868*, collected in the valley of the Pastaza River, between Banos and Cashurco, 8 hours east of Banos, Prov. Tungurahua, Ecuador, alt. 1300–1800 m., 25 Sept. 1923, and deposited in the herbarium of the New York Botanical Garden. It is related to *M. stipularis* Naud. and *M. annulata* Triana, of the section *Amblyarrhena*, and is distinguished from them by the dilated petiole, the shape of the leaf, and the prolonged ridges on the ovary.

Chamber with thermostatic control and rotating table for plant cultures

SAM F. TRELEASE

In attempting to work out plans which will allow certain problems of the salt relations of plants to be attacked in their simplest form, attention has been directed to the initial behavior of germinating seeds.[1] Satisfactory duplication of the experimental conditions in successive series of tests appears less difficult to secure in experiments with very young seedlings than in those with plants in later phases of growth. The whole question of photic environment may be avoided, since such tests can be carried on in darkness, and the temperature conditions to which the plants are subjected may be more easily controlled. Although consistent results have been obtained in repetitions of these experiments without artificial control of temperature, nevertheless it has seemed desirable to employ controlled temperatures in order to have greater certainty in the effective duplication of the influential experimental conditions as well as to test the effects of temperature differences. A study has therefore been made of means of controlling temperature, and this paper describes the culture chamber at present in use. The chamber automatically maintains any desired temperature between 10° and 35° C., with a range of variation not exceeding ± 0.5° C. It is of simple construction, resembling an ordinary refrigerator, and is equipped with a rotating table and a thermostat composed of standard commercial appliances that are easily assembled. Although essentially the same devices are probably in use in many laboratories, descriptions of them are not readily available in the literature. A description of the apparatus may therefore be of interest to workers having similar needs, in physiology, pathology, or bacteriology.

The lower diagram of figure 1 is a longitudinal section of the chamber. The outside dimensions are 57 inches wide, 34 inches deep (to go through an ordinary door), and 40 inches high. The walls are insulated with 7/8-inch spruce, two layers

[1] Trelease, Sam F., and Helen M. Trelease. Growth of wheat roots in salt solutions containing essential ions. Bot. Gaz. **80**: 74–83. *f. 1, 2.* 1925.

of water-proof paper, 2 inches of sheet cork, two layers of water-proof paper, and 7/8-inch oak, the last on the outside. The chamber has 6-inch metal legs, and is raised from the floor by a wooden stand 24 inches high.

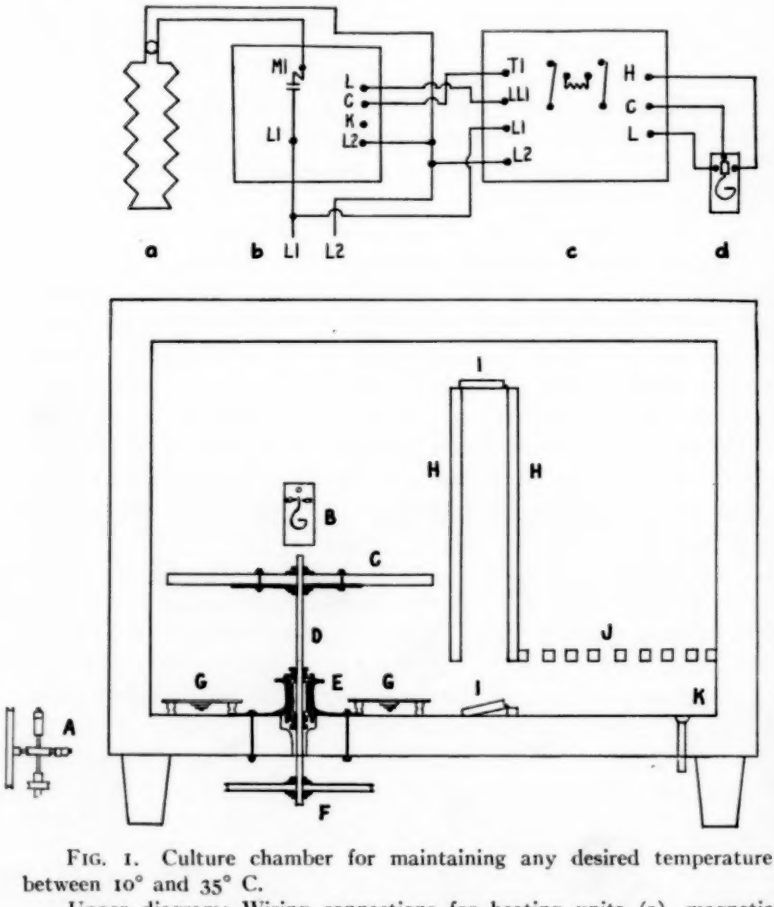

FIG. 1. Culture chamber for maintaining any desired temperature between 10° and 35° C.

Upper diagram: Wiring connections for heating units (a), magnetic switch (b), magnetic relay (c), and thermo-regulator (d).

Lower diagram: Longitudinal section of chamber, showing reducing gear (A), thermo-regulator (B), rotating table (C), shaft (D), motor-cycle hub (E), pulley (F), heating units (G), baffle boards (H), dampers (I), ice rack (J), and drain (K).

The culture compartment (at the left) is 24¼ inches wide, 26½ inches deep, and 32½ inches high; and the ice compart-

ment (at the right) is 17¼ inches wide, 26½ inches deep, and 32½ inches high. The compartments are separated by two 1-inch baffle boards (H) of spruce, 4 inches apart, extending to within 4 inches of the top and to within 5 inches of the bottom of the chamber. A 1-inch partition separates the floor of the ice compartment from that of the rest of the chamber. Dampers (I) that may be operated from the outside of the box serve to regulate the size of the openings above and below the right-hand baffle board, and thus control roughly the circulation of cool air from the ice chamber. A galvanized-iron rack (J) supports ice, when needed, and a drain (K) is provided in the floor.

The culture compartment has a door (24 inches wide and 30 inches high) fitted with three glass plates separated by air layers, permitting inspection of the cultures. A removable curtain of black cloth hangs in front of the door on the outside. Access to the ice compartment is had through another door (15 inches wide and 23 inches high). The entire interior of the ice compartment, the baffle boards, the dampers, and the floor of the culture compartment are covered with galvanized iron. Heavily insulated electric wires lead through two ¼-inch metal tubes in the floor.

In many kinds of biological experimentation it is essential that all comparable cultures be exposed to practically the same temperature conditions, even though fluctuations in temperature are permissible. Such uniformity of exposure is readily obtained by means of the rotating table introduced by Livingston[2] and Shive.[3] It is a pleasure to express indebtedness to Dr. B. E. Livingston, of the Johns Hopkins University, for valuable suggestions regarding the construction of the rotating table here used. The circular table (C) shown in the diagram is 23 inches in diameter and composed of two layers of ⅞-inch white pine with grain crossed to hinder warping. A circular steel plate (3/16 inch thick and 12 inches in diameter) is fastened by four bolts to the bottom of the table. To facilitate air circulation, the marginal part of the table, for a distance of 5½ inches in from the

[2] Livingston, B. E. A rotating table for standardizing porous cup atmometers. Plant World **15**: 157–162. *f. 1, 2.* 1912.

[3] Shive, J. W. A study of physiological balance in nutrient media. Physiol. Res. **1**: 327–397. *f. 1–14.* 1915.

edge, is perforated by many ½-inch holes. Also, six rectangular pieces of sheet "tin," attached to the bottom of the table, tend to stir the air gently and direct currents upward as the table rotates. The table contains a hole at the center and is supported on a threaded steel shaft (D) by means of flanged lock-nuts (2¼ inches in diameter) with washers (4 inches in diameter). The upper part of the shaft (D) is a solid steel rod (⅝ inch in diameter) slightly tapered and driven into the hollow cylindrical axle-bushing of a Harley-Davidson motor cycle front wheel; the middle part of the shaft is the axle-bushing itself, which is threaded and bears cones turning on ball bearings; and the lower part of the shaft is a solid rod driven into the lower end of the axle-bushing. The front-wheel hub (E) is fastened to a circular steel plate (similar to that bolted to the table) by machine screws passing through the spoke holes. The steel plate, with a heavy rubber gasket, is held in place by four bolts. The lower end of the shaft passes through the floor of the box and bears a wooden pulley (F), 14 inches in diameter, held in place by lock-nuts with washers. The pulley is connected by a ¼-inch round belt to a "plant rotator" reducing gear (A), supplied by the Eberbach and Son Company of Ann Arbor, Michigan. The gear is turned by a ¼-horse-power motor (making 1160 rotations a minute). When geared in this way, the table makes a rotation once in 40 seconds. Motor and gear are supported on a stand by themselves, so that their vibrations are not transmitted to the rest of the apparatus.

The temperature near the level of the rotating table is automatically maintained by heat supplied by electric heating units (G) controlled by a thermo-regulator (B) that actuates a relay and switch (located outside the chamber) which open and close the electric circuit through the heating units. A wiring diagram of the thermostat is shown in the upper part of figure 1. The lines supply direct current, 110 volts. A bimetallic thermo-regulator (d) controls heating units (a) through a magnetic relay (c) and a magnetic switch (b).[4] The arrangement is such that when the temperature falls below that for which the thermo-

[4] The thermo-regulator and relay (kindly suggested to the writer by Dr. G. L. Peltier, of the University of Nebraska) are supplied by the Johnson Service Co., of Milwaukee, Wis.; and the magnetic switch is made by the Cutler-Hammer Mfg. Co., of Milwaukee, and designated as no. 193.

regulator is set, the tongue makes contact at the left and closes the circuit through the thermo-regulator and the electro-magnet of the relay; the relay responds so as to close the circuit through the electro-magnet of the switch, which in turn closes the circuit through the heating units. As the temperature rises, the tongue of the thermo-regulator moves away from the contact at the left; and when contact is made at the right, the relay opens the circuit through the electro-magnet of the switch, and a powerful spring breaks the circuit through the heaters. Although the heaters actually carry only about 2 amperes, this thermostat is rated as capable of controlling a current of 50 amperes.

The heating units are similar to those described by Peltier and Goss.[5] Two are connected in series, a pilot light indicating when current is flowing through them. Each has 19 feet of no. 24 nichrome wire[6] wound on a strip of transite (hard asbestos-board) 1 inch wide, 17½ inches long, and ¼ inch thick. This strip is bolted to the lower side of a rectangular piece of transite (7 inches wide and 17½ inches long, and perforated by many 3/16-inch holes drilled about ¾ inch apart), the strip being separated ¼ inch from the larger piece by means of a small square of transite placed at each end. An iron bolt with two nuts holds the three pieces of transite together at each end of the heating unit and also serves as a binding post for wiring connections. The heating unit stands on four porcelain insulators bolted to the transite. The two heating units, connected in series, carry about 1.82 amperes and use 200 watts (on 110 volts), their resistance being 60.4 ohms. The heating power can, of course, be increased by shortening the heating coils, or decreased by lengthening the coils or using a rheostat outside the chamber.[7] As Clark[8] points out, for very accurate temperature control, the heating power of the coils should be adjusted so that the time during which the regulator leaves the heat on, is about as long as the time during which the regulator leaves the

[5] Peltier, G. L., and R. W. Goss. Control equipment for the study of the relation of environment to disease. Coll. Agric. Univ. Nebraska Agric. Exp. Sta. Bull. **28**: 1–16. 1924.

[6] Nichrome wire is made by the Driver-Harris Co., of Harrison, N. J.

[7] The heat supplied is proportional to the wattage (amperes × volts, or volts^2 ÷ ohms, or amperes^2 × ohms).

[8] Clark, W. M. The determination of hydrogen ions. 2nd ed.; Baltimore. 1922.

heat off; or so that the heating rate is about equal to the cooling rate. This insures a regular oscillation about the mean temperature.

The thermostat is easily set for any temperature between 10° C. and 35° C. For a low temperature (below the maximum temperature of the surrounding air), ice is kept in the right-hand compartment and the dampers are adjusted to regulate the circulation of cool air. A temperature considerably lower than 10° probably may be obtained by the use of a freezing mixture of ice and salt, conveniently contained in a galvanized iron tank. For a high temperature, no ice, of course, is needed. After initial adjustment of the thermostat, which may require about one hour, the apparatus operates continuously with little attention, aside from the addition of ice when a low temperature is employed.

Without the use of a fan for rapidly stirring the air, it is of course impossible to secure a uniform distribution of temperature throughout the chamber. Nevertheless, the range of fluctuations in temperature near the level of the rotating table does not exceed ± 0.5° C., and by rotating the cultures near the edge of the circular table all of the cultures are subjected to nearly the same fluctuations. Greater accuracy of control may, of course, be secured by using a more sensitive thermostat, and a more even distribution of temperature throughout the chamber may be obtained by stirring the air by means of a motor-driven fan.

In conclusion, mention should be made of a fact which has doubtless been recognized by many workers, but which is not specially emphasized in the biological literature: namely, that a chamber which gives very accurate results for one portion of the temperature range may give inaccurate results for another portion of the range, although the temperature variation is the same in both cases. This may be illustrated by means of data from Livingston's[9] smoothed growth-temperature graph based upon Lehenbauer's[10] careful studies of maize. If one

[9] Livingston, B. E. Physiological temperature indices for the study of plant growth in relation to climatic conditions. Physiol. Res. **1**: 399–420. *f. 1–4.* 1916.

[10] Lehenbauer, P. A. Growth of maize seedlings in relation to temperature. Physiol. Res. **1**: 247–288. *f. 1–4.* 1914.

culture were exposed to a mean temperature of 31° C. and if another culture in the same chamber were exposed to a mean temperature of 32° C., the corresponding difference in growth rate would amount to only 0.3 per cent—a negligible error in most studies. But if one culture were exposed to 14° C. and another to 15° C., the difference in growth rate would amount to 20.3 per cent—an enormous error. From cases of this sort it is obvious that the error permissible in temperature control depends not only upon the process studied but also upon the sensitiveness of the process at various portions of the temperature range.

Certain studies on physiological balance in culture solutions, now practically completed with the use of the above described apparatus, are to be reported in a future paper.

INDEX TO AMERICAN BOTANICAL LITERATURE

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Abrams, L. R. The origin and geographical affinities of the flora of California. Ecology **6**: 1–6. "Ja" 4 F 1925.

Agati, J. A. The anthracnose of Abaca, or Manila hemp. Philipp. Agr. **13**: 337–344. Ja 1925.

Ames, O. George Lincoln Goodale (1839–1923). Proc. Am. Acad. Arts & Sci. **59**: 640–644. Ja 1925.

Anderson, H. W. *Rhizopus* rot of peaches. Phytopathology **15**: 122–124. "F" 1925.

Anderson, H. W. Shot hole or bacterial spot of peach. Am. Fruit Grow. Mag. **45**: 26, 38–39. F 1925. (Illust.)

Anderson, P. J. Susceptibility of *Nicotiana* species, varieties and hybrids to tobacco wildfire. Phytopathology **15**: 77–84. "F" 1925.

Ashe, W. W. Further notes on woody plants. Torreya **25**: 10–11. Ja–F 1925.
1 species and 2 varieties in *Vaccinium* described as new.

Atanasoff, D. The *Dilophospora* disease of cereals. Phytopathology **15**: 11–40. *f. 1–9*. "Ja" 17 F 1925.

Auten, E., Jr. Findings on X-ray treatment of peony roots for root gall. Flow. Grow. **12**: 67. F 1925.

Baker, F. S. Aspen in the central Rocky Mountain region. U. S. Dept. Agr. Bull. 1291: 1–47. *f. 1–3* + *pl. 1–10*. 20 F 1925.

Ball, C. R., & Whited, K. Pruinose branchlets and *Salix lemmonii* Bebb. Am. Jour. Bot. **12**: 91–96. "F" 4 Mr 1925.

Bannwart, C. Shade trees, the companions of man. Jour. N. Y. Bot. Gard. **26:** 6–10. Ja 1925.

Bartlett, H. H. The varieties of *Corallorrhiza maculata*. Rhodora **27:** 11–14. "Ja" 3 Mr 1925.

Bates, C. G. A key to the identification of some coniferous seedlings. Jour. For. **23:** 278–281. Mr 1925. (Illust.)

Beckwith, C. S. Cranberry disease work in New Jersey. Proc. Am. Cranberry Grow. Assoc. **55:** 11. 1925.

Berger, A. *Roseocactus*, a new genus of Cactaceae. Jour. Washington Acad. Sci. **15:** 43–48. 4 F 1925. (Illust.)
1 genus and 3 species, described as new.

Bresadola, G. New species of fungi. Mycologia **17:** 68–77. 1 Mr 1925.
Many species and 1 variety, described as new.

Britton, E. G. *Gentiana crinita*. Jour. N. Y. Bot. Gard. **26:** 40–41. F 1925.

Britton, N. L. The Pinetum, the collection of evergreen trees Jour. N. Y. Bot. Gard. **26:** 1–3. Ja 1925.

Britton, N. L. Resignation of Doctor Murrill. Jour. N. Y. Bot. Gard. **26:** 13. Ja 1925.

Brooke, W. L. The essential oil of calantas wood. Philipp. Jour. Sci. **26:** 1–7. *pl. 1.* Ja 1925.

Brooks, S. C. The electrical conductivity of pure protoplasm. Jour. Gen. Physiol. **7:** 327–330. 20 Ja 1925.

Brown, W. H., & Kienholz, R. *Cycas chamberlainii*, a new species. Philipp. Jour. Sci. **26:** 47–51. *f. 1 + pl. 2.* Ja 1925.

Calkins, H. G. In defense of brush. Jour. For. **23:** 30–33. Ja 1925.

Cannon, W. A. On the upper critical concentration of oxygen in root growth. Science II. **61:** 118–120. 30 Ja 1925.

Chamberlain, C. J. The origin of the cycads. Science II. **61:** 73–77. 23 Ja 1925.

Chamberlain, E. B. On a new variety of *Encalypta vulgaris* from New Mexico. Bryologist **28:** 4–6. *pl. 1.* "Ja" 20 F 1925.

Chipman, R. H. A study of synizesis and synapsis in *Lilium superbum* L. Am. Jour. Bot. **12**: 1–18. *pl. 1–4.* "Ja" 16 F 1925.

Clute, W. N. Cold and color in plants. Gard. Chron. Am. **29**: 36. F 1925.

Clute, W. N. The meaning of plant names—XXII. Solanaceae. Am. Bot. **31**: 8–16. Ja 1925.

Clute, W. N. The white snakeroot. Am. Bot. **31**: 1–3. Ja 1925. (Illust.)

Clute, W. N. White strawberries. Am. Bot. **31**: 27–28. Ja 1925.

Cockerell, T. D. A. Chimera in head of sunflower. Jour. Hered. **16**: 2. (Frontispiece.) "Ja" 20 F 1925.

Collinson, R. C. The presence of certain organic compounds in plants and their relation to the growth of other plants. Jour. Am. Soc. Agron. **17**: 58–68. Ja 1925.

Cook, M. T. El dominio del matizado de la caña de azúcar. Rev. Agr. Puerto Rico **14**: 7–9. Ja 1925.

Cook, M. T. Sugar cane seed selection. Seed cane and cane disease. Best cane on plantation not too valuable for seed. Facts About Sugar **20**: 138. 7 F 1925.

Coville, F. V. The agricultural use of acid peats. Jour. Am. Peat Soc. **13**: 5–7. *pl. 1–4.* Ja 1925.

Craig, W. N. Notes on poisonous plants. Gard. Chron. Am. **29**: 38. F 1925.

Cunningham, M. P. New uses for native plants. Country Life Am. **47**: 35–39. F 1925. (Illust).

Daly, P. M. A preliminary report on jonathan breakdown. Sci. Agr. **5**: 155–165. *f. 1–6.* Ja 1925.

David, P. A. Correlation between number of leaves and height of *Nicotiana tabacum*. Philipp. Agr. **13**: 345–348. Ja 1925.

Dicks, S. B. The tomato (*Lycopersicon esculentum* Miller; *Solanum lycopersicum* Linn.). Gard. Chron. III. **77**: 98–99. *f. 40.* 7 F 1925.

Dickson, B. T. Plant pathology in Canada. Sci. Agr. **5**: 211–217. Mr 1925. (Illust.)

Diddell, W. D. Some tropical vines. Am. Bot. **31**: 22–25. Ja 1925.

Drechsler, C. Root-rot of peas in the middle Atlantic states in 1924. Phytopathology **15**: 110–114. "F" 1925.

Duruz, W. P. California peach blight or shot-hole fungus. Blue Anchor **2**: 15, 38. F 1925. (Illust.)

East, E. M., & Mangelsdorf, A. J. A new interpretation of the hereditary behavior of self-sterile plants. Proc. Nat. Acad. Sci. **11**: 166–171. F 1925.

Faris, J. A., & Reed, G. M. Modes of infection of sorghums by loose kernel smut. Mycologia **17**: 51–67. *pl. 5–7.* 1 Mr 1925.

Fawcett, H. S. Observations on bark diseases of citrus trees in Sicily. Phytopathology **15**: 41–42. "Ja" 17 F 1925.

Fernald, M. L. American representatives of *Lonicera caerulea*. Rhodora **27**: 1–11. "Ja" 3 Mr 1925.
1 species, 2 varieties and 2 combinations described as new.

Fraser, W. P. Culture experiments with heteroecious rusts in 1922, 1923 and 1924. Mycologia **17**: 78–86. 1 Mr 1925.

Frost, H. B. The chromosomes of *Citrus*. Jour. Washington Acad. Sci. **15**: 1–3. *f. 1–2.* 4 Ja 1925.

Gates, F. C. Hemerarch and feratarch, two additional terms in ecology. Science II. **61**: 260. 6 Mr 1925.

Gilbert, W. W., & Artschwager, E. Watermelon internal browning. Phytopathology **15**: 119–121. *f. 1.* "F" 1925.

Gleason, H. A. Species and area. Ecology **6**: 66–74. "Ja" 4 F 1925.

Gleason, H. A. Studies on the flora of northern South America —II. The stellate-tomentose species of *Centropogon*. Bull. Torrey Club **52**: 1–20. *pl. 1.* 31 Ja 1925.
Many species described as new.

Gratz, L. O. Blight diseases of Irish potatoes. Univ. Florida Agr. Exp. Sta. Press Bull. 366: 1–2. 10 F 1925.

Grier, N. M. Unreported plants from Long Island, N. Y. II. Cryptogams exclusive of Pteridophyta. Torreya **25:** 5–10. Ja–F 1925. II. Cryptogams— Part 2. Ibid. 29–35. 22 Ap 1925.

Grier, N. M. The fossil flora of the vicinity of Cold Spring Harbor. Am. Midl. Nat. **9:** 513–527. Jl 1925.

Grier, N. M. The geology of Long Island with especial reference to the Cold Spring Harbor region and its flora. Am. Midl. Nat. **9:** 531–563. *map.* S 1925.

Including: Partial bibliography of the flora of Long Island and vicinity, pp. 550–563.

Grier, N. M. The native flora of the vicinity of Cold Spring Harbor, N. Y. Am. Midl. Nat. **9:** 245–256. "S–N" 1924; 283–318. "Ja" 1925; 384–437. "My" 1925.

Hamblin, S. F. Catkins of the spring. Nat. Mag. **5:** 182–184. Mr 1925. (Illust.)

Hamblin, S. F. Red twigs and yellow. Nat. Mag. **5:** 87–88, 134. F 1925. (Illust.)

Hanford, C. G. Forms of mosaic disease. Jour. Jamaica Agr. Soc. **29:** 13–14. Ja 1925.

Hansen, A. A. Dutchman's breeches. Nat. Mag. **5:** 150. Mr 1925. (Illust.)

Hansen, A. A. Hepatica, harbinger of spring. Nat. Mag. **5:** 74. F 1925. (Illust.)

Hansen, A. A. Notes on the contiol of water weeds. Jour. Am. Soc. Agron. **17:** 119–120. F 1925.

Hansen, A. A. The pitcher plant of the north, south and west. Nat. Mag. **5:** 21–24. Ja 1925. (Illust.)

Harlan, H. V., & Pope, M. N. Some cases of apparent single fertilization in barley. Am. Jour. Bot. **12:** 50–53. *pl. 6.* "Ja" 16 F 1925.

Harris, J. A., Hoffman, W. F., & Johnson A. H. The reaction of the cotton plant. Science II. **61:** 65. 16 Ja 1925.

Hastings, G. T. Some tree buds. Torreya **25:** 1–3. *pl. 1.* Ja–F 1925.

Heath, F. M. The high-bush cranberry. Am. Bot. **31**: 3–5. Ja 1925.

Henderson, N. F. The chickory family in Ohio. Ohio Jour. Sci. **25**: 85–96. "Mr" 20 F 1925.

Herbert, D. A., & Pacis, A. L. The odor of *Amorphophallus campanulatus*. Philipp. Agr. **13**: 349–350. Ja 1925.

Hitchcock, A. S. Botanizing in Bolivia. Sci. Mo. **20**: 163–175. F 1925. (Illust.)

Hitchcock, A. S. Botanizing in Peru. Sci. Mo. **20**: 47–63. Ja 1925. (Illust.)

Hollick, A. A new fossil species of *Hydrangea*. Bull. Torrey Club **52**: 21–22. *pl. 2*. 31 Ja 1925.
Hydrangea alaskana.

Holmes, S. J. "Age and area" in relation to extinction. Science II. **61**: 77–79. 23 Ja 1925.

Holzinger, J. M. *Grimmia poecilostoma* (*Grimmia Cardoti* Héribaud). Bryologist **28**: 7–8. "Ja" 20 F 1925.

Holzinger, J. M. *Pottia Randii* not a *Pottia*. Bryologist **28**: 6. "Ja" 20 F 1925.

Howe, M. A. Ezra Brainerd. Jour. N. Y. Bot. Gard. **26**: 12–13. Ja 1925.
Born 17 D 1844. Died 8 D 1924.

Illick, J. S. Will the chestnut come back? Am. For. & For. Life **31**: 7–9. Ja 1925. (Illust.)

Itano, A. Biological investigation of peat. Jour. Bact. **10**: 87–95. Ja 1925.

Jeffrey, E. C. The origin of parenchyma in geological time. Proc. Nat. Acad. Sci. **11**: 106–110. *f. 1–5*. Ja 1925.

Jeffrey, E. C. Resin canals in the evolution of the conifers. Proc. Nat. Acad. Sci. **11**: 101–105. *f. 1–4*. Ja 1925.

Jehle, R. A. Black spot or bacterial crack of the peach. Trans. Peninsula Hort. Soc. **14**: 15–16. 1925.

Jenkins, A. E. Brown canker of roses. Mycologia **17**: 87–88. 1 Mr 1925.

Jenkins, A. E. The citrus scab fungus. Phytopathology **15:** 99–104. *f. 1–4.* "F" 1925.
Sphaceloma Fawcettii, described as new.

Johnson, A. T. Some American rhododendrons. Gard. Chron. Am. **29:** 34, 44. F 1925.

Jones, W., & Perkins, M. E. The nitrogenous groups of plant nucleic acid. Jour. Biol. Chem. **62:** 557–564. Ja 1925.

Killip, E. P. Notes on Peruvian Urticaceae of the Marshall Field exploration. Jour. Washington Acad. Sci. **15:** 48–56. 4 F 1925.
8 species in *Urtica*, *Pilea* and *Myriocarpa*, described as new.

Kilmer, F. B. Rambling among the nightshades. Am. Jour. Pharm. **97:** 4–38. Ja 1925. (Illust.)

Kirk, L. E. Artificial self-pollination of red clover. Sci. Agr. **5:** 179–189. *f. 1–3.* F 1925.

Knott, J. E. Effect of cold temperature on growth of vegetables. Jour. Am. Soc. Agron. **17:** 54–57. Ja 1925.

Knott, J. E. Effect of soaking seeds of some vegetables before sowing. Jour. Am. Soc. Agron. **17:** 49–54. Ja 1925.

Korstian, C. F. Some ecological effects of shading coniferous nursery stock. Ecology **6:** 48–51. *f. 1.* "Ja" 4 F 1925.

Kuhn, J., & Girard, A. Nematodes (concl.) Through the Leaves **13:** 18–19. Ja 1925.

Kummel, J. F. Relative water-holding capacity of sphagnum and tree moss. Jour. For. **23:** 181–182. F 1925.

Landsell, K. A. Weeds of South Africa. XV. The water hyacinth *Eichornia speciosa* Kunth. Order Pontederiaceae. Jour. Dept. Agr. So. Africa **10:** 24–28. *pl. 1–4.* Ja 1925.

Levene, P. A., & Rolf, I. P. Plant phosphatides I. Lecithin and cephalin of the soybean. Jour. Biol. Chem. **62:** 759–766. Ja 1925.

Levine, V. E. The effect of selenium compounds upon growth and germination in plants. Am. Jour. Bot. **12:** 82–90. "F" 4 Mr 1925.

McLaughlin, B. E. Yucca trees of the Mojave desert. Am. For. & For. Life **31**: 107–108. F 1925. (Illust.)

McMurray, N. Wild crabapples. Am. Bot. **31**: 5–8. Ja 1925.

Mangenot, G. Sur le mode de formation des graines d'amidon dans les laticifères des Euphorbiacées. Comp. Rend. Seances Acad. Sci. Paris **180**: 157–160. 12 Ja 1925. (Illust).

Martin, E. M. Cultural and morphological studies of some species of *Taphrina*. Phytopathology **15**: 67–76. *f. 1–2.* "F" 1925.

Martin, W. H. Plant diseases of New Jersey. The losses they cause (Third installment). New Jersev Agr. **7**: 12. F 1925.

Matz, J. El mal del banano. Hacienda **20**: 43–45. F 1925. (Illust.)

Meinecke, E. P. Forest protection— Diseases. Jour. For. **23**: 260–267. Mr 1925.

Mitchell, G. E. Date gardens of America. Nat. Mag. **5**: 106–110. F 1925. (Illust.)

Moudgill, K. L. Travancore essential oils: From the leaves of *Lantana camara*. II. Parfum & Essential Oil Rec. **16**: 9–10. Ja 1925.

Mousley, H. *Amesia latifolia* in Canada. Orchid Rev. 33: 6–7. Ja 1925.

Murrill, W. A. The trees of St. Augustine. Jour. N. Y. Bot. Gard. **26**: 36–38. F 1925.

Musgrave, G. W. Soil formation and alfalfa yields. Extensive survey bears out some old beliefs. New Jersey Agr. **7**: 16. F 1925. (Illust.)

Nelson, N. T. The effects of frequent cutting on the production, root reserves and behavior of alfalfa. Jour. Am. Soc. Agron. **17**: 100–113. F 1925.

Norton, G. F. The fringed gentian. Jour. N. Y. Bot. Gard. **26**: 38–40. *f. 5.* F 1925.

Norton, J. B. S. Some interesting work on tomato seed breeding and selection. Seed World **17**: 12. Ja 1925. (Illust.)

Olitsky, P. K. Experiments on the cultivation of the active agent of mosaic disease in tobacco and tomato plants. Jour. Exp. Med. **41**: 129–136. Ja 1925.

Pack, A. N., & Pack, E. The forest primeval. Nat. Mag. **5**: 82–84, 105. F 1925. (Illust.)

Peck, M. E. A preliminary sketch of the plant regions of Oregon—I. Western Oregon. Am. Jour. Bot. **12**: 33–49. *f. 1.* "Ja" 16 F 1925; II. The Cascade Mountains and eastward. Am. Jour. Bot. **12**: 69–83. "F" 4 Mr 1925.

Pessin, L. J. An ecological study of the polypody fern *Polypodium polypodioides* as an epiphyte in Mississippi. Ecology **6**: 17–38. *f. 1–3* + *pl. 1.* "Ja "4 F 1925.

Pickett, F. L. The life history of *Ricciocarpus natans*. Bryologist **28**: 1–3. "Ja" 20 F 1925.

Plakidas, A. G. *Fusarium* rot of the peach. Phytopathology **15**: 92–98. *f. 1–6.* "F" 1925.

Poole, R. F. Sweet potatoes threatened by another serious disease. New Jersey Agr. **7**: 12. F 1925. (Illust.)

Putnam, B. L. How grandmother kept well. Nat. Mag. **5**: 42–44. Ja 1925. (Illust.)

Rawlins, T. E., & Johnson, J. Cytological studies of the mosaic disease of tobacco. Am. Jour. Bot. **12**: 19–32. *pl. 5.* "Ja" 16 F 1925.

Record, S. J. The persimmon's farthest north. Am. For. & For. Life **31**: 88. F 1925. (Illust.)

Redpath, W. H. A planter's experience with mosaic disease and the planting of Uba cane. Jour. Jamaica Agr. Soc. **29**: 18–21. Ja 1925.

Rigg, G. B. The utilization of sphagnum bogs on the west coast. Jour. Am. Peat. Soc. **18**: 9–12. Ja 1925.

Robbins, W. W. Some fundamental principles of plant growth II. Absorption by the roots. Through the Leaves **13**: 7–11. Ja 1925. (Illust.); III. Food building. Through the Leaves **13**: 39. F 1925. (Illust.)

Robertson-Proschowsky, A. *Acanthosabal:* nov. gen. Gard. Chron. III. **77:** 91–92. *f. 35–36.* 7 F 1925.

Robinson, B. L. Count Solms. (1843–1915) Proc. Am. Acad. Arts & Sci. **59:** 651–656. Ja 1925.

Robinson, C. H. Some water loving dune flowers. Flow. Grow. **12:** 1–3. Ja 1925. (Illust.)

Rusby, H. H. Tropical American plants at home—IV. The huckleberry family in the Andes. Jour. N. Y. Bot. Gard. **26:** 31–36. F 1925.

St. John, H., & Parker, C. S. A tetramerous species, section, and subgenus of *Carex*. Am. Jour. Bot. **12:** 63–68. *pl. 7.* "Ja" 16 F 1925.
A subgenus *Altericarex*, and a section *Tetragonae*, described as new.

Seaver, F. J. Fungi and insects. Jour. N. Y. Bot. Gard. **26:** 10–12. Ja 1925.

Seaver, F. J. Studies in tropical Ascomycetes—III. Porto Rican cup-fungi. Mycologia **17:** 45–50. *pl. 4.* 1 Mr 1925.
9 species and 1 combination, described as new.

Setchell, W. A. Frank Shipley Collins. 1848–1920. Am. Jour. Bot. **12:** 54–62. "Ja" 16 F 1925. (Illust.)
Born 6 F 1848. Died 25 My 1920.

Sherbakoff, C. D. Effect of soil treatment with sulphur upon crown gall in nursery apple trees. Phytopathology **15:** 105–109. *f. 1–3.* "F" 1925.

Shufeldt, R. W. Venus's fly-trap, a carnivorous plant from Florida. Guide to Nature **17:** 129–131. *f. 1–3.* F 1925.

Small, J. K. A new whitlow-wort from Florida. Torreya **25:** 11–12. Ja–F 1925.
Nyachia pulvinata, described as new.

Smith, R. E. Current problems in plant disease. Calif. Countrym. **11:** 9–10, 22. Ja 1925. (Illust.)

Soares, A. J. Some of the tender exotics of California. Flow. Grow. **12:** 89–91. Mr 1925. (Illust.)

Staker, E. V. The effect of dry heat on alfalfa seed and its adulterants. Jour. Am. Soc. Agron. **17:** 32–40. Ja 1925.

Standley, P. C. New plants from Central America. Jour. Washington Acad. Sci. **15**: 3–9. 4 Ja 1925.
Many species, described as new.

Standley, P. C., & Calderón, S. Lista preliminar de las plantas de El Salvador. 1–174. San Salvador, 14 F 1925.
Including several new combinations.

Stevens, N. E. Eunice Rockwood Oberly, 1878–1921. Phytopathology **15**: 61–64. *pl. 2.* "F" 1925.
Born 7 Mr 1878. Died 5 N 1921.

Stevens, N. E. Field observations on false blossom of the cultivated cranberry. Phytopathology **15**: 85–91. "F" 1925.

Stevens, N. E. First award of the Eunice Rockwood Oberly memorial prize. Phytopathology **15**: 65–66. "F" 1925.
To Mr. Max Meisel for v. 1 of his Bibliography of American Natural History, 1769–1865.

Stevens, N. E. Notes on blueberry and cranberry diseases. Proc. Am. Cranberry Grow. Assoc. **55**: 7, 10. 1925.

Stewart, G. Forest types of the northern swamps. Jour. For. **23**: 160–172. F 1925. (Illust.)

Stout, A. B. Avocado studies—pollination and setting of fruit. Florida Grow. **31**: 6–7. 24 Ja 1925.

Stout, A. B. Self-incompatibility in wild species of apples. Jour. N. Y. Bot. Gard. **26**: 25–31. *f. 1–4.* F 1925.

Stover, W. G. Augustine Dawson Selby, 1859–1924. Phytopathology **15**: 1–10. *pl. 1.* "Ja" 17 F 1925.
Born 2 S 1859. Died 7 My 1924.

Tilford, P., Abel, C. F., & Hibbard, R. P. An injurious factor affecting the seeds of *Phaseolus vulgaris* soaked in water. Papers Mich. Acad. Sci. **4**: 345–356. *f. 8.* F 1925.

Trelease, S. F., & Yule, E. S. Preparation of scientific and technical papers. 1–113. Baltimore, 1925.

Verret, J. A., Kulsunai, U. K. D., Conant, R., & Smith, T. A method of handling cane tassels for breeding work. Hawaiian Pl. Rec. **29**: 84–94. Ja 1925. (Illust.)

Walker, J. C. Studies on disease resistance in the onion. Proc. Nat. Acad. Sci. **11**: 183–189. *f. 1.* 15 Mr 1925.

Warren, P. A. Genetic studies in *Lycopersicum*. 1. The heredity of fruit shape in the garden tomato. Papers Mich. Acad. Sci. **4**: 357–394. F 1925.

Wehmeyer, L. E. The perfect stage of the Valsaceae in culture and the hypothesis of sexual strains in this group. Papers Mich. Acad. Sci. **4**: 395–412. *pl. 19.* F 1925.

Wherry, E. T. The story of the box huckleberry. Nat. Mag. **5**: 238–240. Ap 1925. (Illust.)

Williams, R. S. *Orthorrhynchium chilense* sp. nov. Bryologist **27**: 87–88. *f. 1–9.* "N 1924" 15 Ja 1925.

Williams, R. S. *Pseudoleskea Baileyi* Best & Grout. Bryologist **27**: 92. *pl. 13.* "N 1924" 15 Ja 1925.

Wimmer, F. E. Lobelioideae. II (continuatio diagnos. original.). Repert. Spec. Nov. Regn. Veg. **19**: 385–392. 30 Ap 1924.
Including descriptions of new species from Mexico and South America.

Wilson, E. H. The Carolina hemlock. Horticulture n. s. **3**: 115. 15 Mr 1925. (Illust.)

Wilson, E. H. The cherries of Japan. House & Gard. **47**: 92–93, 114, 116, 122. Mr 1925. (Illust.)

Wilson, E. H. Hardy azaleas. Country Life **57**: 339–340; 444–445. 7 –21 Mr 1925. (Illust.)

Wolf, F. A. Bacterial pustule of soybean. Jour. Agr. Res. **29**: 57–68. *f. 1–4 + pl. 1–3.* 15 Jl 1924.

Woodcock, E. F. Observations on the morphology of the seed in *Phytolacca*. Papers Mich. Acad. Sci. **4**: 413–418. *pl. 20–21.* F 1925.

Wunder, B. Experiencias culturales con distintos trigos efectuadas en el campo de ensayos de la sección genética. Bol. Soc. Nac. Agr. Chile **56**: 65–70. F 1925. (Illust.)

Yoder, P. A. Hot-water treatment of dormant and sprouted seed corn. U. S. Dept. Agr. Circ. 337: 1–4. F 1925.